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**Fahlgren et al.**

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(54) **SYSTEM AND METHOD FOR MANAGING  
CONFERENCING IN A DISTRIBUTED  
COMMUNICATION NETWORK**

(56) **References Cited**

U.S. PATENT DOCUMENTS

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5,274,700 A 12/1993 Gechter et al.  
5,283,819 A \* 2/1994 Glick ..... H04M 11/00  
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(Continued)

FOREIGN PATENT DOCUMENTS

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DE 1684587 A 3/1971  
EP 0282126 A 9/1988

(Continued)

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OTHER PUBLICATIONS

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“Ethernet to Token ring Bridge”—Black Box Corporation, Oct.  
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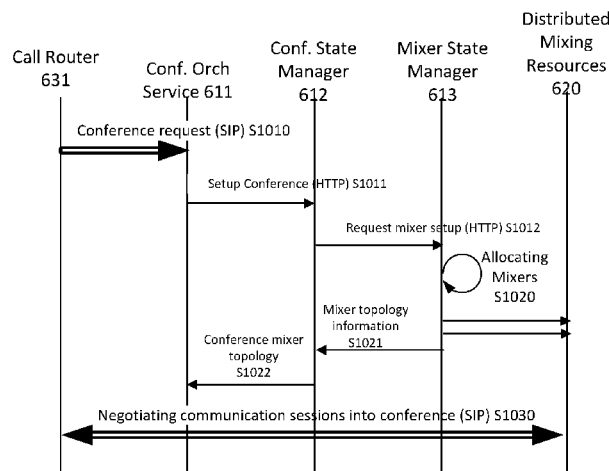
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(57) **ABSTRACT**

Systems and methods for a conferencing system. Responsive to a new conference request received at a conference orchestration service, participants of the conference and participant regions for each determined participant are determined. A mixer topology is generated that specifies an assignment of each determined participant to at least one input channel of a plurality of mixers. A mixer state manager generates the mixer topology based on the determined participant regions and at least one regional association of a mixer. Media of each determined participant is routed to the assigned at least one input channel according to the generated mixer topology by using the conference orchestration service. The mixer state manager generates the topology responsive to a request provided by the conference state manager. The conference orchestration service receives the

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generated mixer topology from the mixer state manager via the conference state manager.

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### (56) References Cited

#### U.S. PATENT DOCUMENTS

5,526,416 A 6/1996 Dezonno et al.  
5,581,608 A 12/1996 Jreij et al.  
5,598,457 A 1/1997 Foladare et al.  
5,867,495 A 2/1999 Elliott et al.  
5,934,181 A 8/1999 Adamczewski  
5,978,465 A 11/1999 Corduroy et al.  
6,026,440 A 2/2000 Shrader et al.  
6,034,946 A 3/2000 Roginsky et al.  
6,094,681 A 7/2000 Shaffer et al.  
6,138,143 A 10/2000 Gigliotti et al.  
6,185,565 B1 2/2001 Meubus et al.  
6,192,123 B1 2/2001 Grunsted et al.  
6,206,564 B1 3/2001 Adamczewski  
6,223,287 B1 4/2001 Douglas et al.  
6,232,979 B1 5/2001 Shochet  
6,269,336 B1 7/2001 Ladd et al.  
6,317,137 B1 11/2001 Rosasco  
6,363,065 B1 3/2002 Thornton et al.  
6,373,836 B1 4/2002 Deryugin et al.  
6,425,012 B1 7/2002 Trovato et al.  
6,426,995 B1 7/2002 Kim et al.  
6,430,175 B1 8/2002 Echols et al.  
6,434,528 B1 8/2002 Sanders  
6,445,694 B1 9/2002 Swartz  
6,445,776 B1 9/2002 Shank et al.  
6,459,913 B2 10/2002 Cloutier  
6,463,414 B1 10/2002 Su et al.  
6,493,558 B1 12/2002 Bernhart et al.  
6,496,500 B2 12/2002 Nance et al.  
6,501,739 B1 12/2002 Cohen  
6,501,832 B1 12/2002 Saylor et al.  
6,507,875 B1 1/2003 Mellen-Garnett et al.  
6,571,245 B2 5/2003 Huang et al.  
6,574,216 B1 6/2003 Farris et al.  
6,577,721 B1 6/2003 Vainio et al.

6,600,736 B1 6/2003 Ball et al.  
6,606,596 B1 8/2003 Zirngibl et al.  
6,614,783 B1 9/2003 Sonesh et al.  
6,625,258 B1 9/2003 Ram et al.  
6,625,576 B2 9/2003 Kochanski et al.  
6,636,504 B1 10/2003 Albers et al.  
6,662,231 B1 12/2003 Drosset et al.  
6,704,785 B1 3/2004 Koo et al.  
6,707,889 B1 3/2004 Saylor et al.  
6,711,129 B1 3/2004 Bauer et al.  
6,711,249 B2 3/2004 Weissman et al.  
6,738,738 B2 5/2004 Henton  
6,757,365 B1 6/2004 Bogard  
6,765,997 B1 7/2004 Zirngibl et al.  
6,768,788 B1 7/2004 Langseth et al.  
6,778,653 B1 8/2004 Kallas et al.  
6,785,266 B2 8/2004 Swartz  
6,788,768 B1 9/2004 Saylor et al.  
6,792,086 B1 9/2004 Saylor et al.  
6,792,093 B2 9/2004 Barak et al.  
6,798,867 B1 9/2004 Zirngibl et al.  
6,807,529 B2 10/2004 Johnson et al.  
6,807,574 B1 10/2004 Partovi et al.  
6,819,667 B1 11/2004 Brusilovsky et al.  
6,820,260 B1 11/2004 Flockhart et al.  
6,829,334 B1 12/2004 Zirngibl et al.  
6,831,966 B1 12/2004 Tegan et al.  
6,834,265 B2 12/2004 Balasuriya  
6,836,537 B1 12/2004 Zirngibl et al.  
6,842,767 B1 1/2005 Partovi et al.  
6,850,603 B1 2/2005 Eberle et al.  
6,870,830 B1 3/2005 Schuster et al.  
6,873,952 B1 3/2005 Bailey et al.  
6,885,737 B1 4/2005 Gao et al.  
6,874,084 B1 5/2005 Dobner et al.  
6,888,929 B1 5/2005 Saylor et al.  
6,895,084 B1 5/2005 Saylor et al.  
6,898,567 B2 5/2005 Balasuriya  
6,912,581 B2 6/2005 Johnson et al.  
6,922,411 B1 7/2005 Taylor  
6,928,469 B1 8/2005 Duursma et al.  
6,931,405 B2 8/2005 El-Shimi et al.  
6,937,699 B1 8/2005 Schuster et al.  
6,940,953 B1 9/2005 Eberle et al.  
6,941,268 B2 9/2005 Porter et al.  
6,947,417 B2 9/2005 Laursen et al.  
6,947,988 B1 9/2005 Saleh  
6,961,330 B1 11/2005 Cattani et al.  
6,964,012 B1 11/2005 Zirngibl et al.  
6,970,915 B1 11/2005 Partovi et al.  
6,977,992 B2 12/2005 Zirngibl et al.  
6,981,041 B2 12/2005 Araujo et al.  
6,985,862 B2 1/2006 Stroem et al.  
6,999,576 B2 2/2006 Sacra  
7,003,464 B2 2/2006 Ferrans et al.  
7,006,606 B1 2/2006 Cohen et al.  
7,010,586 B1 3/2006 Allavarpu et al.  
7,020,685 B1 3/2006 Chen et al.  
7,039,165 B1 5/2006 Saylor et al.  
7,058,042 B2 6/2006 Bontempi et al.  
7,058,181 B2 6/2006 Wright et al.  
7,062,709 B2 6/2006 Cheung  
7,065,637 B1 6/2006 Nanja  
7,076,037 B1 7/2006 Gonen et al.  
7,076,428 B2 7/2006 Anastasakos et al.  
7,089,310 B1 8/2006 Ellerman et al.  
7,099,442 B2 8/2006 Da Palma et al.  
7,103,003 B2 9/2006 Brueckheimer et al.  
7,103,171 B1 9/2006 Annadata et al.  
7,106,844 B1 9/2006 Holland  
7,111,163 B1 9/2006 Haney  
7,136,932 B1 11/2006 Schneider  
7,140,004 B1 11/2006 Kunins et al.  
7,143,039 B1 11/2006 Stifelman et al.  
7,197,331 B2 3/2007 Anastasakos et al.  
7,197,461 B1 3/2007 Eberle et al.  
7,197,462 B2 3/2007 Takagi et al.  
7,197,544 B2 3/2007 Wang et al.  
D540,074 S 4/2007 Peters

(56)

## References Cited

## U.S. PATENT DOCUMENTS

7,225,232 B2	5/2007	Elberse	7,875,836 B2	1/2011	Imura et al.
7,227,849 B1	6/2007	Rasanen	7,882,253 B2	2/2011	Pardo-Castellote et al.
7,245,611 B2	7/2007	Narasimhan et al.	7,920,866 B2	4/2011	Bosch et al.
7,260,208 B2	8/2007	Cavalcanti	7,926,099 B1	4/2011	Chakravarty et al.
7,266,181 B1	9/2007	Zirngibl et al.	7,929,562 B2	4/2011	Petrovykh
7,269,557 B1	9/2007	Bailey et al.	7,929,684 B2	4/2011	Hostetler
7,272,212 B2	9/2007	Eberle et al.	7,936,867 B1	5/2011	Hill et al.
7,272,564 B2	9/2007	Phillips et al.	7,949,111 B2	5/2011	Harlow et al.
7,277,851 B1	10/2007	Henton	7,962,644 B1	6/2011	Ezerzer et al.
7,283,515 B2	10/2007	Fowler	7,979,555 B2	7/2011	Rothstein et al.
7,283,519 B2	10/2007	Girard	7,992,120 B1	8/2011	Wang et al.
7,286,521 B1	10/2007	Jackson et al.	8,023,425 B2	9/2011	Raleigh
7,287,248 B1	10/2007	Adeeb	8,024,785 B2	9/2011	Andress et al.
7,289,453 B2	10/2007	Riedel et al.	8,045,689 B2	10/2011	Provenzale et al.
7,296,739 B1	11/2007	Mo et al.	8,046,378 B1	10/2011	Zhuge et al.
7,298,732 B2	11/2007	Cho	8,046,823 B1	10/2011	Begen et al.
7,298,834 B1	11/2007	Homeier et al.	8,069,096 B1	11/2011	Ballaro et al.
7,308,085 B2	12/2007	Weissman	8,078,483 B1	12/2011	Hirose et al.
7,308,408 B1	12/2007	Stifelman et al.	8,081,744 B2	12/2011	Sylvain
7,324,633 B2	1/2008	Gao et al.	8,081,958 B2	12/2011	Soederstroem et al.
7,324,942 B1	1/2008	Mahowald et al.	8,103,725 B2	1/2012	Gupta et al.
7,328,263 B1	2/2008	Sadjadi	8,126,128 B1	2/2012	Hicks, III et al.
7,330,463 B1	2/2008	Bradd et al.	8,126,129 B1 *	2/2012	McGuire ..... H04M 3/568 379/202.01
7,330,890 B1	2/2008	Partovi et al.	8,130,750 B2	3/2012	Hester
7,340,040 B1	3/2008	Saylor et al.	8,130,917 B2	3/2012	Helbling et al.
7,349,714 B2	3/2008	Lee et al.	8,139,730 B2	3/2012	Palma et al.
7,369,865 B2	5/2008	Gabriel et al.	8,145,212 B2	3/2012	Lopresti et al.
7,370,329 B2	5/2008	Kumar et al.	8,149,716 B2	4/2012	Ramanathan et al.
7,373,660 B1	5/2008	Guichard et al.	8,150,918 B1	4/2012	Edelman et al.
7,376,223 B2	5/2008	Taylor et al.	8,156,213 B1	4/2012	Deng et al.
7,376,586 B1	5/2008	Partovi et al.	8,165,116 B2	4/2012	Ku et al.
7,376,733 B2	5/2008	Connelly et al.	8,166,185 B2	4/2012	Samuel et al.
7,376,740 B1	5/2008	Porter et al.	8,175,007 B2	5/2012	Jain et al.
7,412,525 B2	8/2008	Cafarella et al.	8,185,619 B1	5/2012	Maiocco et al.
7,418,090 B2	8/2008	Reding et al.	8,196,133 B2	6/2012	Kakumani et al.
7,428,302 B2	9/2008	Zirngibl et al.	8,214,868 B2	7/2012	Hamilton et al.
7,440,898 B1	10/2008	Eberle et al.	8,218,457 B2	7/2012	Malhotra et al.
7,447,299 B1	11/2008	Partovi et al.	8,233,611 B1	7/2012	Zettner
7,454,459 B1	11/2008	Kapoor et al.	8,238,533 B2	8/2012	Blackwell et al.
7,457,249 B2	11/2008	Baldwin et al.	8,243,889 B2	8/2012	Taylor et al.
7,457,397 B1	11/2008	Saylor et al.	8,249,552 B1	8/2012	Gailloux et al.
7,473,872 B2	1/2009	Takimoto	8,266,327 B2	9/2012	Kumar et al.
7,486,780 B2	2/2009	Zirngibl et al.	8,295,272 B2	10/2012	Boni et al.
7,496,054 B2	2/2009	Taylor	8,301,117 B2	10/2012	Keast et al.
7,496,188 B2	2/2009	Saha et al.	8,306,021 B2	11/2012	Lawson et al.
7,496,651 B1	2/2009	Joshi	8,315,198 B2	11/2012	Corneille et al.
7,500,249 B2	3/2009	Kampe et al.	8,315,369 B2	11/2012	Lawson et al.
7,505,951 B2	3/2009	Thompson et al.	8,315,620 B1	11/2012	Williamson et al.
7,519,359 B2	4/2009	Chiarulli et al.	8,319,816 B1	11/2012	Swanson et al.
7,522,711 B1	4/2009	Stein et al.	8,326,805 B1	12/2012	Arous et al.
7,536,454 B2	5/2009	Balasuriya	8,335,852 B2	12/2012	Hokimoto
7,542,761 B2	6/2009	Sarkar	8,346,630 B1	1/2013	McKeown
7,552,054 B1	6/2009	Stifelman et al.	8,355,394 B2	1/2013	Taylor et al.
7,571,226 B1	8/2009	Partovi et al.	8,411,669 B2	4/2013	Chen et al.
7,606,868 B1	10/2009	Le et al.	8,413,247 B2	4/2013	Hudis et al.
7,613,287 B1	11/2009	Stifelman et al.	8,417,817 B1	4/2013	Jacobs
7,623,648 B1	11/2009	Oppenheim et al.	8,429,827 B1	4/2013	Wetzel
7,630,900 B1	12/2009	Strom	8,438,315 B1	5/2013	Tao et al.
7,631,310 B1	12/2009	Henzinger	8,462,670 B2	6/2013	Chien et al.
7,644,000 B1	1/2010	Strom	8,467,502 B2	6/2013	Sureka et al.
7,657,433 B1	2/2010	Chang	8,477,926 B2	7/2013	Jasper et al.
7,657,434 B2	2/2010	Thompson et al.	8,503,639 B2	8/2013	Reding et al.
7,668,157 B2	2/2010	Weintraub et al.	8,503,650 B2	8/2013	Reding et al.
7,672,275 B2	3/2010	Yajnik et al.	8,504,818 B2	8/2013	Rao et al.
7,672,295 B1	3/2010	Andhare et al.	8,509,068 B2	8/2013	Begall et al.
7,675,857 B1	3/2010	Chesson	8,532,686 B2	9/2013	Schmidt et al.
7,676,221 B2	3/2010	Roundtree et al.	8,533,857 B2	9/2013	Tuchman et al.
7,685,280 B2	3/2010	Berry et al.	8,542,805 B2	9/2013	Agranovsky et al.
7,685,298 B2	3/2010	Day et al.	8,543,665 B2	9/2013	Ansari et al.
7,715,547 B2	5/2010	Ibbotson et al.	8,547,962 B2	10/2013	Ramachandran et al.
7,716,293 B2	5/2010	Kasuga et al.	8,549,047 B2	10/2013	Beechuk et al.
7,742,499 B1	6/2010	Erskine et al.	8,565,117 B2	10/2013	Hilt et al.
7,779,065 B2	8/2010	Gupta et al.	8,572,391 B2	10/2013	Golan et al.
7,809,125 B2	10/2010	Brunson et al.	8,576,712 B2	11/2013	Sabat et al.
7,809,791 B2	10/2010	Schwartz et al.	8,577,803 B2	11/2013	Chatterjee et al.
			8,582,450 B1	11/2013	Robesky
			8,582,737 B2	11/2013	Lawson et al.
			8,594,626 B1	11/2013	Woodson et al.

# US 10,757,200 B2

Page 4

(56)	References Cited			2002/0133587 A1	9/2002	Ensel et al.	
	U.S. PATENT DOCUMENTS			2002/0136391 A1	9/2002	Armstrong	
				2002/0165957 A1	11/2002	Devoe et al.	
				2002/0167936 A1 *	11/2002	Goodman .....	H04L 41/5003 370/352
8,601,136 B1	12/2013	Fahlgren et al.	2002/0176378 A1	11/2002	Hamilton et al.		
8,611,338 B2	12/2013	Lawson et al.	2002/0184361 A1	12/2002	Eden		
8,613,102 B2	12/2013	Nath	2002/0198941 A1	12/2002	Gavrilescu et al.		
8,621,598 B2	12/2013	Lai et al.	2003/0006137 A1	1/2003	Wei et al.		
8,649,268 B2	2/2014	Lawson et al.	2003/0012356 A1	1/2003	Zino et al.		
8,656,452 B2	2/2014	Li et al.	2003/0014665 A1	1/2003	Anderson et al.		
8,667,056 B1	3/2014	Proulx et al.	2003/0018830 A1	1/2003	Chen et al.		
8,675,493 B2	3/2014	Buddhikot et al.	2003/0023672 A1	1/2003	Vaysman		
8,688,147 B2	4/2014	Nguyen et al.	2003/0026426 A1	2/2003	Wright et al.		
8,695,077 B1	4/2014	Gerhard et al.	2003/0046366 A1	3/2003	Pardikar et al.		
8,713,693 B2	4/2014	Shanabrook et al.	2003/0051037 A1	3/2003	Sundaram et al.		
8,728,656 B2	5/2014	Takahashi et al.	2003/0058884 A1	3/2003	Kallner et al.		
8,751,801 B2	6/2014	Harris et al.	2003/0059020 A1	3/2003	Meyerson et al.		
8,755,376 B2	6/2014	Lawson et al.	2003/0060188 A1	3/2003	Gidron et al.		
8,767,925 B2	7/2014	Sureka et al.	2003/0061317 A1	3/2003	Brown et al.		
8,781,975 B2	7/2014	Bennett et al.	2003/0061404 A1	3/2003	Atwal et al.		
8,797,920 B2	8/2014	Parreira	2003/0088421 A1	5/2003	Maes et al.		
8,806,024 B1	8/2014	Francis et al.	2003/0097330 A1	5/2003	Hillmer et al.		
8,819,133 B2	8/2014	Wang	2003/0097447 A1	5/2003	Johnston		
8,825,746 B2	9/2014	Ravichandran	2003/0097639 A1	5/2003	Niyogi et al.		
8,837,465 B2	9/2014	Lawson et al.	2003/0103620 A1	6/2003	Brown et al.		
8,838,707 B2	9/2014	Lawson et al.	2003/0123640 A1	7/2003	Roelle et al.		
8,843,596 B2	9/2014	Goel et al.	2003/0149721 A1	8/2003	Alfonso-Nogueiro et al.		
8,855,271 B2	10/2014	Brock	2003/0162506 A1	8/2003	Toshimitsu et al.		
8,861,510 B1	10/2014	Fritz	2003/0195950 A1	10/2003	Huang et al.		
8,879,547 B2	11/2014	Maes	2003/0195990 A1	10/2003	Greenblat		
8,903,938 B2	12/2014	Vermeulen et al.	2003/0196076 A1	10/2003	Zabarski et al.		
8,918,848 B2	12/2014	Sharma et al.	2003/0204616 A1	10/2003	Billhartz et al.		
8,924,489 B2	12/2014	Bleau et al.	2003/0211842 A1	11/2003	Kempf et al.		
8,938,053 B2	1/2015	Cooke et al.	2003/0231647 A1	12/2003	Petrovykh		
8,948,356 B2	2/2015	Nowack et al.	2003/0233276 A1	12/2003	Pearlman et al.		
8,954,591 B2	2/2015	Ganesan et al.	2004/0008635 A1	1/2004	Nelson et al.		
8,964,726 B2	2/2015	Lawson et al.	2004/0011690 A1	1/2004	Marfino et al.		
8,990,610 B2	3/2015	Bostick et al.	2004/0044953 A1	3/2004	Watkins et al.		
9,014,664 B2	4/2015	Kim et al.	2004/0052349 A1	3/2004	Creamer et al.		
9,015,702 B2	4/2015	Bhat	2004/0071275 A1	4/2004	Bowater et al.		
9,031,223 B2	5/2015	Smith et al.	2004/0101122 A1	5/2004	Palma et al.		
9,071,677 B2	6/2015	Aggarwal et al.	2004/0102182 A1	5/2004	Reith et al.		
9,137,127 B2	9/2015	Nowack	2004/0117788 A1	6/2004	Karaoguz et al.		
9,141,682 B1	9/2015	Adoc, Jr. et al.	2004/0136324 A1	7/2004	Steinberg et al.		
9,161,296 B2	10/2015	Parsons et al.	2004/0165569 A1	8/2004	Sweatman et al.		
9,177,007 B2	11/2015	Winters et al.	2004/0172482 A1	9/2004	Weissman et al.		
9,204,281 B2	12/2015	Ramprasad et al.	2004/0199572 A1	10/2004	Hunt et al.		
9,210,275 B2	12/2015	Lawson et al.	2004/0205101 A1	10/2004	Radhakrishnan		
9,246,694 B1	1/2016	Fahlgren et al.	2004/0205689 A1	10/2004	Ellens et al.		
9,306,982 B2	4/2016	Lawson et al.	2004/0213400 A1	10/2004	Golitsin et al.		
9,307,094 B2	4/2016	Nowack et al.	2004/0216058 A1	10/2004	Chavers et al.		
9,325,624 B2	4/2016	Malatack et al.	2004/0218748 A1	11/2004	Fisher		
9,338,190 B2	5/2016	Eng et al.	2004/0228469 A1	11/2004	Andrews et al.		
9,344,573 B2	5/2016	Wolthuis	2004/0236696 A1	11/2004	Aoki et al.		
9,356,916 B2	5/2016	Kravitz et al.	2004/0240649 A1	12/2004	Goel		
9,378,337 B2	6/2016	Kuhr	2005/0005109 A1	1/2005	Castaldi et al.		
9,398,622 B2	7/2016	Lawson et al.	2005/0005200 A1	1/2005	Matena et al.		
9,456,008 B2	9/2016	Lawson et al.	2005/0010483 A1	1/2005	Ling		
9,456,339 B1	9/2016	Hildner et al.	2005/0015505 A1	1/2005	Kruis et al.		
9,460,169 B2	10/2016	Hinton et al.	2005/0021626 A1	1/2005	Prajapat et al.		
9,553,900 B2	1/2017	Fahlgren et al.	2005/0025303 A1	2/2005	Hostetler		
9,596,274 B2	3/2017	Lawson et al.	2005/0038772 A1	2/2005	Colrain		
9,628,624 B2	4/2017	Wolthuis et al.	2005/0043952 A1	2/2005	Sharma et al.		
9,632,875 B2	4/2017	Raichstein et al.	2005/0047579 A1	3/2005	Salame		
9,634,995 B2	4/2017	Binder	2005/0060411 A1	3/2005	Coulombe et al.		
2001/0016491 A1 *	8/2001	Imura .....	2005/0083907 A1	4/2005	Fishler		
		H04W 88/02 455/432.1	2005/0091336 A1	4/2005	DeHamer et al.		
2001/0038624 A1	11/2001	Greenberg et al.	2005/0091572 A1	4/2005	Gavrilescu et al.		
2001/0043684 A1	11/2001	Guedalia et al.	2005/0108770 A1	5/2005	Karaoguz et al.		
2001/0051996 A1	12/2001	Cooper et al.	2005/0125251 A1	6/2005	Berger et al.		
2002/0006124 A1	1/2002	Jimenez et al.	2005/0125739 A1	6/2005	Thompson et al.		
2002/0006125 A1	1/2002	Josse et al.	2005/0128961 A1	6/2005	Miloslaysky et al.		
2002/0006193 A1	1/2002	Rodenbusch et al.	2005/0135578 A1	6/2005	Ress et al.		
2002/0025819 A1	2/2002	Cetusic et al.	2005/0141500 A1	6/2005	Bhandari et al.		
2002/0057777 A1	5/2002	Saito et al.	2005/0147088 A1	7/2005	Bao et al.		
2002/0064267 A1	5/2002	Martin et al.	2005/0177635 A1	8/2005	Schmidt et al.		
2002/0067823 A1	6/2002	Walker et al.	2005/0181835 A1	8/2005	Lau et al.		
2002/0077833 A1	6/2002	Arons et al.	2005/0198292 A1	9/2005	Duursma et al.		
2002/0126813 A1	9/2002	Partovi et al.					

(56)

## References Cited

## U.S. PATENT DOCUMENTS

2005/0228680	A1	10/2005	Malik		2008/0037746	A1	2/2008	Dufrene et al.
2005/0238153	A1	10/2005	Chevalier		2008/0040484	A1	2/2008	Yardley
2005/0240659	A1	10/2005	Taylor		2008/0049617	A1	2/2008	Grice et al.
2005/0243977	A1	11/2005	Creamer et al.		2008/0052395	A1	2/2008	Wright et al.
2005/0246176	A1	11/2005	Creamer et al.		2008/0091843	A1	4/2008	Kulkarni
2005/0286498	A1*	12/2005	Rand	H04M 3/42382 370/352	2008/0101571	A1	5/2008	Harlow et al.
2005/0289222	A1	12/2005	Sahim		2008/0104348	A1	5/2008	Kabzinski et al.
2006/0008065	A1	1/2006	Longman et al.		2008/0120702	A1	5/2008	Hokimoto
2006/0008073	A1	1/2006	Yoshizawa et al.		2008/0123559	A1	5/2008	Haviv et al.
2006/0008256	A1	1/2006	Khedouri et al.		2008/0134049	A1	6/2008	Gupta et al.
2006/0015467	A1	1/2006	Morken et al.		2008/0139166	A1	6/2008	Agarwal et al.
2006/0021004	A1	1/2006	Moran et al.		2008/0146268	A1	6/2008	Gandhi et al.
2006/0023676	A1	2/2006	Whitmore et al.		2008/0152101	A1	6/2008	Griggs
2006/0047666	A1	3/2006	Bedi et al.		2008/0154601	A1	6/2008	Stifelman et al.
2006/0067506	A1	3/2006	Flockhart et al.		2008/0155029	A1	6/2008	Helbling et al.
2006/0080415	A1	4/2006	Tu		2008/0162482	A1	7/2008	Ahern et al.
2006/0098624	A1	5/2006	Morgan et al.		2008/0165708	A1	7/2008	Moore et al.
2006/0129638	A1	6/2006	Deakin		2008/0172404	A1	7/2008	Cohen
2006/0143007	A1	6/2006	Koh et al.		2008/0177883	A1	7/2008	Hanai et al.
2006/0146792	A1	7/2006	Ramachandran et al.		2008/0192736	A1	8/2008	Jabri et al.
2006/0146802	A1	7/2006	Baldwin et al.		2008/0201426	A1	8/2008	Darcie
2006/0168334	A1	7/2006	Potti et al.		2008/0209050	A1	8/2008	Li
2006/0203979	A1	9/2006	Jennings		2008/0212945	A1	9/2008	Khedouri et al.
2006/0209695	A1	9/2006	Archer et al.		2008/0222656	A1	9/2008	Lyman
2006/0212865	A1	9/2006	Vincent et al.		2008/0229421	A1	9/2008	Hudis et al.
2006/0215824	A1	9/2006	Mitby et al.		2008/0232574	A1	9/2008	Baluja et al.
2006/0217823	A1	9/2006	Hussey		2008/0235230	A1	9/2008	Maes
2006/0217978	A1	9/2006	Mitby et al.		2008/0256224	A1	10/2008	Kaji et al.
2006/0222166	A1	10/2006	Ramakrishna et al.		2008/0275741	A1	11/2008	Loeffen
2006/0256816	A1	11/2006	Yarlagadda et al.		2008/0307436	A1	12/2008	Hamilton
2006/0262915	A1	11/2006	Marascio et al.		2008/0310599	A1	12/2008	Purnadi et al.
2006/0270386	A1	11/2006	Yu et al.		2008/0313318	A1	12/2008	Vermeulen et al.
2006/0285489	A1	12/2006	Francisco et al.		2008/0316931	A1	12/2008	Qiu et al.
2007/0002744	A1	1/2007	Mewhinney et al.		2008/0317222	A1	12/2008	Griggs et al.
2007/0036143	A1	2/2007	Alt et al.		2008/0317232	A1	12/2008	Couse et al.
2007/0038499	A1	2/2007	Margulies et al.		2008/0317233	A1	12/2008	Rey et al.
2007/0043681	A1	2/2007	Morgan et al.		2009/0046838	A1	2/2009	Andreasson
2007/0050306	A1	3/2007	McQueen		2009/0052437	A1	2/2009	Taylor et al.
2007/0064672	A1	3/2007	Raghav et al.		2009/0052641	A1	2/2009	Taylor et al.
2007/0070906	A1	3/2007	Thakur		2009/0059894	A1	3/2009	Jackson et al.
2007/0070980	A1	3/2007	Phelps et al.		2009/0063502	A1	3/2009	Coimbatore et al.
2007/0071223	A1	3/2007	Lee et al.		2009/0074159	A1	3/2009	Goldfarb et al.
2007/0074174	A1	3/2007	Thornton		2009/0075684	A1	3/2009	Cheng et al.
2007/0088836	A1	4/2007	Tai et al.		2009/0083155	A1	3/2009	Tudor et al.
2007/0091907	A1	4/2007	Seshadri et al.		2009/0089165	A1	4/2009	Sweeney
2007/0107048	A1	5/2007	Halls et al.		2009/0089352	A1	4/2009	Davis et al.
2007/0116191	A1	5/2007	Bermudez et al.		2009/0089699	A1	4/2009	Saha et al.
2007/0121651	A1	5/2007	Casey et al.		2009/0093250	A1	4/2009	Jackson et al.
2007/0127691	A1	6/2007	Lert		2009/0125608	A1	5/2009	Werth et al.
2007/0127703	A1	6/2007	Siminoff		2009/0129573	A1	5/2009	Gavan et al.
2007/0130260	A1	6/2007	Weintraub et al.		2009/0136011	A1	5/2009	Goel
2007/0133771	A1	6/2007	Stifelman et al.		2009/0170496	A1	7/2009	Bourque
2007/0147351	A1	6/2007	Dietrich et al.		2009/0171659	A1	7/2009	Pearce et al.
2007/0149166	A1	6/2007	Turcotte et al.		2009/0171669	A1	7/2009	Engelsma et al.
2007/0153711	A1	7/2007	Dykas et al.		2009/0171752	A1	7/2009	Galvin et al.
2007/0153712	A1*	7/2007	Fry	H04L 29/06027 370/263	2009/0182896	A1	7/2009	Patterson et al.
2007/0167170	A1	7/2007	Fitchett et al.		2009/0193433	A1	7/2009	Maes
2007/0192629	A1	8/2007	Saito		2009/0216835	A1*	8/2009	Jain
2007/0201448	A1	8/2007	Baird et al.		2009/0216935	A1*	8/2009	Flick
2007/0208862	A1	9/2007	Fox et al.		2009/0217293	A1	8/2009	Wolber et al.
2007/0232284	A1	10/2007	Mason et al.		2009/0220057	A1	9/2009	Waters
2007/0239761	A1	10/2007	Baio et al.		2009/0221310	A1	9/2009	Chen et al.
2007/0242626	A1	10/2007	Altberg et al.		2009/0222341	A1	9/2009	Belwadi et al.
2007/0255828	A1	11/2007	Paradise		2009/0225748	A1	9/2009	Taylor
2007/0265073	A1	11/2007	Novi et al.		2009/0225763	A1	9/2009	Forsberg et al.
2007/0286180	A1	12/2007	Marquette et al.		2009/0228868	A1	9/2009	Drukman et al.
2007/0291734	A1	12/2007	Bhatia et al.		2009/0232289	A1	9/2009	Drucker et al.
2007/0291905	A1	12/2007	Halliday et al.		2009/0234965	A1	9/2009	Viveganandhan et al.
2007/0293200	A1	12/2007	Roundtree et al.		2009/0235349	A1	9/2009	Lai et al.
2007/0295803	A1	12/2007	Levine et al.		2009/0241135	A1	9/2009	Wong et al.
2008/0005275	A1	1/2008	Overton et al.		2009/0252159	A1	10/2009	Lawson et al.
2008/0025320	A1	1/2008	Bangalore et al.		2009/0276771	A1	11/2009	Nickolov et al.
2008/0037715	A1	2/2008	Prozeniuk et al.		2009/0288012	A1	11/2009	Udo et al.
					2009/0288165	A1	11/2009	Qiu et al.
					2009/0300194	A1	12/2009	Ogasawara
					2009/0316687	A1	12/2009	Kruppa
					2009/0318112	A1	12/2009	Vasten

(56)

## References Cited

## U.S. PATENT DOCUMENTS

2010/0027531	A1	2/2010	Kurashima	2011/0313950	A1	12/2011	Nuggehalli et al.
2010/0037204	A1	2/2010	Lin et al.	2011/0320449	A1	12/2011	Gudlavenkatasiva
2010/0054142	A1	3/2010	Moiso et al.	2011/0320550	A1	12/2011	Lawson et al.
2010/0070424	A1	3/2010	Monk	2012/0000903	A1	1/2012	Baarmaan et al.
2010/0071053	A1	3/2010	Ansari et al.	2012/0011274	A1	1/2012	Moreman
2010/0082513	A1	4/2010	Liu	2012/0017222	A1	1/2012	May
2010/0087215	A1	4/2010	Gu et al.	2012/0023531	A1	1/2012	Meuninck et al.
2010/0088187	A1	4/2010	Courtney et al.	2012/0023544	A1	1/2012	Li et al.
2010/0088698	A1	4/2010	Krishnamurthy	2012/0027228	A1	2/2012	Rijken et al.
2010/0094758	A1	4/2010	Chamberlain et al.	2012/0028602	A1	2/2012	Lisi et al.
2010/0103845	A1	4/2010	Ulupinar et al.	2012/0036574	A1	2/2012	Heithcock et al.
2010/0107222	A1	4/2010	Glasser	2012/0039202	A1	2/2012	Song
2010/0115041	A1	5/2010	Hawkins et al.	2012/0059709	A1	3/2012	Lieberman et al.
2010/0138501	A1	6/2010	Clinton et al.	2012/0079066	A1	3/2012	Li et al.
2010/0142516	A1	6/2010	Lawson et al.	2012/0083266	A1	4/2012	VanSwol et al.
2010/0150139	A1	6/2010	Lawson et al.	2012/0089572	A1	4/2012	Raichstein et al.
2010/0167689	A1	7/2010	Sepehri-Nik et al.	2012/0094637	A1	4/2012	Jeyaseelan et al.
2010/0184408	A1*	7/2010	Vendrow ..... H04M 3/42153 455/411	2012/0101952	A1	4/2012	Raleigh et al.
2010/0188979	A1	7/2010	Thubert et al.	2012/0110564	A1	5/2012	Ran et al.
2010/0191915	A1	7/2010	Spencer	2012/0114112	A1	5/2012	Rauschenberger et al.
2010/0208881	A1	8/2010	Kawamura	2012/0149404	A1	6/2012	Beattie et al.
2010/0217837	A1	8/2010	Ansari et al.	2012/0166488	A1	6/2012	Kaushik et al.
2010/0217982	A1	8/2010	Brown et al.	2012/0170726	A1	7/2012	Schwartz
2010/0232594	A1	9/2010	Lawson et al.	2012/0173610	A1	7/2012	Bleau et al.
2010/0235539	A1	9/2010	Carter et al.	2012/0174095	A1	7/2012	Natchadalingam et al.
2010/0250946	A1	9/2010	Korte et al.	2012/0179907	A1	7/2012	Byrd et al.
2010/0251329	A1	9/2010	Wei	2012/0180021	A1	7/2012	Byrd et al.
2010/0251340	A1	9/2010	Martin et al.	2012/0180029	A1	7/2012	Hill et al.
2010/0265825	A1	10/2010	Blair et al.	2012/0198004	A1	8/2012	Watte
2010/0281108	A1	11/2010	Cohen	2012/0201238	A1	8/2012	Lawson et al.
2010/0291910	A1	11/2010	Sanding et al.	2012/0208495	A1	8/2012	Lawson et al.
2010/0312919	A1	12/2010	Lee et al.	2012/0221603	A1	8/2012	Kothule et al.
2010/0332852	A1	12/2010	Vembu et al.	2012/0226579	A1	9/2012	Ha et al.
2011/0026516	A1	2/2011	Roberts et al.	2012/0239757	A1	9/2012	Firstenberg et al.
2011/0029882	A1	2/2011	Jaisinghani	2012/0240226	A1	9/2012	Li
2011/0029981	A1	2/2011	Jaisinghani	2012/0246273	A1	9/2012	Bomstein et al.
2011/0053555	A1	3/2011	Cai et al.	2012/0254828	A1	10/2012	Aiylam et al.
2011/0078278	A1	3/2011	Cui et al.	2012/0281536	A1	11/2012	Gell et al.
2011/0081008	A1	4/2011	Lawson et al.	2012/0288082	A1	11/2012	Segall
2011/0083069	A1	4/2011	Paul et al.	2012/0290706	A1	11/2012	Lin et al.
2011/0083179	A1	4/2011	Lawson et al.	2012/0304245	A1	11/2012	Lawson et al.
2011/0093516	A1	4/2011	Geng et al.	2012/0304275	A1	11/2012	Ji et al.
2011/0096673	A1	4/2011	Stevenson et al.	2012/0316809	A1	12/2012	Egolf et al.
2011/0110366	A1	5/2011	Moore et al.	2012/0321058	A1	12/2012	Eng et al.
2011/0131293	A1	6/2011	Mori	2012/0321070	A1	12/2012	Smith et al.
2011/0143714	A1	6/2011	Keast et al.	2013/0029629	A1	1/2013	Lindholm et al.
2011/0145049	A1	6/2011	Udo et al.	2013/0031158	A1	1/2013	Salsburg
2011/0149810	A1*	6/2011	Koren ..... H04L 12/1827 370/261	2013/0036476	A1	2/2013	Roever et al.
2011/0149950	A1	6/2011	Petit-Huguenin et al.	2013/0047232	A1	2/2013	Tuchman et al.
2011/0151884	A1	6/2011	Zhao	2013/0054684	A1	2/2013	Brazier et al.
2011/0167172	A1	7/2011	Roach et al.	2013/0058262	A1	3/2013	Parreira
2011/0170505	A1	7/2011	Rajasekar et al.	2013/0067232	A1	3/2013	Cheung et al.
2011/0176537	A1	7/2011	Lawson et al.	2013/0067448	A1	3/2013	Sannidhanam et al.
2011/0179126	A1	7/2011	Wetherell et al.	2013/0097298	A1	4/2013	Ting et al.
2011/0211679	A1	9/2011	Mezhibovsky et al.	2013/0110658	A1	5/2013	Lyman et al.
2011/0251921	A1	10/2011	Kassaei et al.	2013/0132573	A1	5/2013	Lindblom
2011/0253693	A1	10/2011	Lyons et al.	2013/0139148	A1	5/2013	Berg et al.
2011/0255675	A1	10/2011	Jasper et al.	2013/0156024	A1	6/2013	Burg
2011/0258432	A1	10/2011	Rao et al.	2013/0166580	A1	6/2013	Maharajh et al.
2011/0261804	A1*	10/2011	Antoine ..... H04L 29/12594 370/342	2013/0179942	A1	7/2013	Caplis et al.
2011/0265168	A1	10/2011	Lucovsky et al.	2013/0201909	A1	8/2013	Bosch et al.
2011/0265172	A1	10/2011	Sharma et al.	2013/0204786	A1	8/2013	Mattes et al.
2011/0267985	A1	11/2011	Wilkinson et al.	2013/0212603	A1	8/2013	Cooke et al.
2011/0274111	A1	11/2011	Narasappa et al.	2013/0244632	A1	9/2013	Spence et al.
2011/0276892	A1	11/2011	Jensen-Horne et al.	2013/0268676	A1	10/2013	Martins et al.
2011/0276951	A1	11/2011	Jain	2013/0325934	A1	12/2013	Fausak et al.
2011/0280390	A1	11/2011	Lawson et al.	2013/0328997	A1	12/2013	Desai
2011/0283259	A1	11/2011	Lawson et al.	2013/0336472	A1	12/2013	Fahlgren et al.
2011/0289126	A1	11/2011	Aikas et al.	2014/0025503	A1	1/2014	Meyer et al.
2011/0289162	A1	11/2011	Furlong et al.	2014/0058806	A1	2/2014	Guenette et al.
2011/0299672	A1	12/2011	Chiu et al.	2014/0064467	A1	3/2014	Lawson et al.
2011/0310902	A1	12/2011	Xu	2014/0072115	A1	3/2014	Makagon et al.
				2014/0073291	A1	3/2014	Hildner et al.
				2014/0095627	A1	4/2014	Romagnino
				2014/0101058	A1	4/2014	Castel et al.
				2014/0105372	A1	4/2014	Nowack et al.
				2014/0106704	A1	4/2014	Cooke et al.
				2014/0122600	A1	5/2014	Kim et al.
				2014/0123187	A1	5/2014	Reisman

(56)

**References Cited****U.S. PATENT DOCUMENTS**

2014/0126715 A1 5/2014 Lum et al.  
 2014/0129363 A1 5/2014 Lorah et al.  
 2014/0153565 A1 6/2014 Lawson et al.  
 2014/0185490 A1 7/2014 Holm et al.  
 2014/0254600 A1 9/2014 Shibata et al.  
 2014/0258481 A1 9/2014 Lundell  
 2014/0269333 A1 9/2014 Boerjesson  
 2014/0274086 A1 9/2014 Boerjesson et al.  
 2014/0282473 A1 9/2014 Saraf et al.  
 2014/0289391 A1 9/2014 Balaji et al.  
 2014/0304054 A1 10/2014 Orun et al.  
 2014/0355600 A1 12/2014 Lawson et al.  
 2014/0372508 A1 12/2014 Fausak et al.  
 2014/0372509 A1 12/2014 Fausak et al.  
 2014/0372510 A1 12/2014 Fausak et al.  
 2014/0373098 A1 12/2014 Fausak et al.  
 2014/0379670 A1 12/2014 Kuhr  
 2015/0004932 A1 1/2015 Kim et al.  
 2015/0004933 A1 1/2015 Kim et al.  
 2015/0023251 A1 1/2015 Giakoumelis et al.  
 2015/0026477 A1 1/2015 Malatack et al.  
 2015/0066865 A1 3/2015 Yara et al.  
 2015/0081918 A1 3/2015 Nowack et al.  
 2015/0082378 A1 3/2015 Collison  
 2015/0100634 A1 4/2015 He et al.  
 2015/0119050 A1 4/2015 Liao et al.  
 2015/0181631 A1 6/2015 Lee et al.  
 2015/0236905 A1 8/2015 Bellan et al.  
 2015/0281294 A1 10/2015 Nur et al.  
 2015/0365480 A1 12/2015 Soto et al.  
 2015/0370788 A1 12/2015 Bareket et al.  
 2016/0006574 A1 1/2016 Fahlgren et al.  
 2016/0011758 A1 1/2016 Dornbush et al.  
 2016/0077693 A1 3/2016 Meyer et al.  
 2016/0088028 A1 3/2016 Fahlgren et al.  
 2016/0112475 A1 4/2016 Lawson et al.  
 2016/0112521 A1 4/2016 Lawson et al.  
 2016/0119291 A1 4/2016 Zollinger et al.  
 2016/0127254 A1 5/2016 Kumar et al.  
 2016/0149956 A1 5/2016 Birnbaum et al.  
 2016/0162172 A1 6/2016 Rathod  
 2016/0205519 A1 7/2016 Patel et al.  
 2016/0226937 A1 8/2016 Patel et al.  
 2016/0226979 A1 8/2016 Lancaster et al.  
 2016/0239770 A1 8/2016 Batabyal et al.  
 2017/0339283 A1 11/2017 Chaudhary et al.

**FOREIGN PATENT DOCUMENTS**

EP 1464418 A 10/2004  
 EP 1522922 4/2005  
 EP 1770586 A1 4/2007  
 EP 2053869 A1 4/2009

ES 2134107 A 9/1999  
 JP 10294788 4/1998  
 JP 2004166000 A 6/2004  
 JP 2004220118 A 8/2004  
 JP 2006319914 A 11/2006  
 WO 9732448 A 9/1997  
 WO 2002087804 11/2002  
 WO 2006037492 A 4/2006  
 WO WO-2009018489 A2 2/2009  
 WO 2009124223 A 10/2009  
 WO 2010037064 A 4/2010  
 WO 2010040010 A 4/2010  
 WO 2010101935 A 9/2010  
 WO 2011091085 A 7/2011

**OTHER PUBLICATIONS**

Abu-Lebdeh et al. "A 3GPP Evolved Packet Core-Based Architecture for QoS-Enabled Mobile Video Surveillance Applications". 2012 Third International Conference on the Network of the Future (NOF). Nov. 21-23, 2012. pp. 1-6.  
 Archive Microsoft Office 365 Email | Retain Unified Archiving, 2015, GWAVA, Inc., Montreal, Canada.  
 Complaint for Patent Infringement, *Telinit Technologies, LLC v. Twilio Inc.*, dated Oct. 12, 2012.  
 Kim et al. "In-service Feedback QoE Framework" 2010 Third International Conference on Communication Theory, Reliability and Quality of Service. pp. 135-138. 2010.  
 Matos et al. "Quality of Experience-based Routing in Multi-Service Wireless Mesh Networks" Realizing Advanced Video Optimized Wireless Networks. IEEE. pp. 7060-7065. 2012.  
 NPL, "API Monetization Platform", 2013.  
 RFC 3986: Uniform Resource Identifier (URI): Generic Syntax; T. Berners-Lee, R. Fielding, L. Masinter; Jan. 2005; The Internet Society.  
 S. barakovic and L. Skorin-Kapov. "Survey and Challenges of QoE Management Issues in Wireless Networks". 2012, pp. 1-29.  
 Subramanya, et al. "Digital Signatures", IEEE Potentials, Mar./Apr. 2006, pp. 5-8.  
 Tran et al. "User to User adaptive routing based on QoE" ICNS 2011: The Seventh International Conference on Networking and Services. pp. 170-177. 2011.  
 Twilio Cloud Communications—APIs for Voice, VoIP, and Text Messaging, Twilio.  
 Wu et al. "Quality Evaluation in Peer-to-Peer IPTV Services" Data Traffic and Monitoring Analysis, LNCS 7754. pp. 302-319. 2013.  
 "U.S. Appl. No. 14/791,759, Corrected Notice of Allowance dated Oct. 21, 2015", 2 pgs.  
 "U.S. Appl. No. 14/791,759, Notice of Allowance dated Sep. 15, 2015", 8 pgs.  
 "U.S. Appl. No. 14/964,266, Notice of Allowance dated Sep. 12, 2016", 15 pgs.

\* cited by examiner

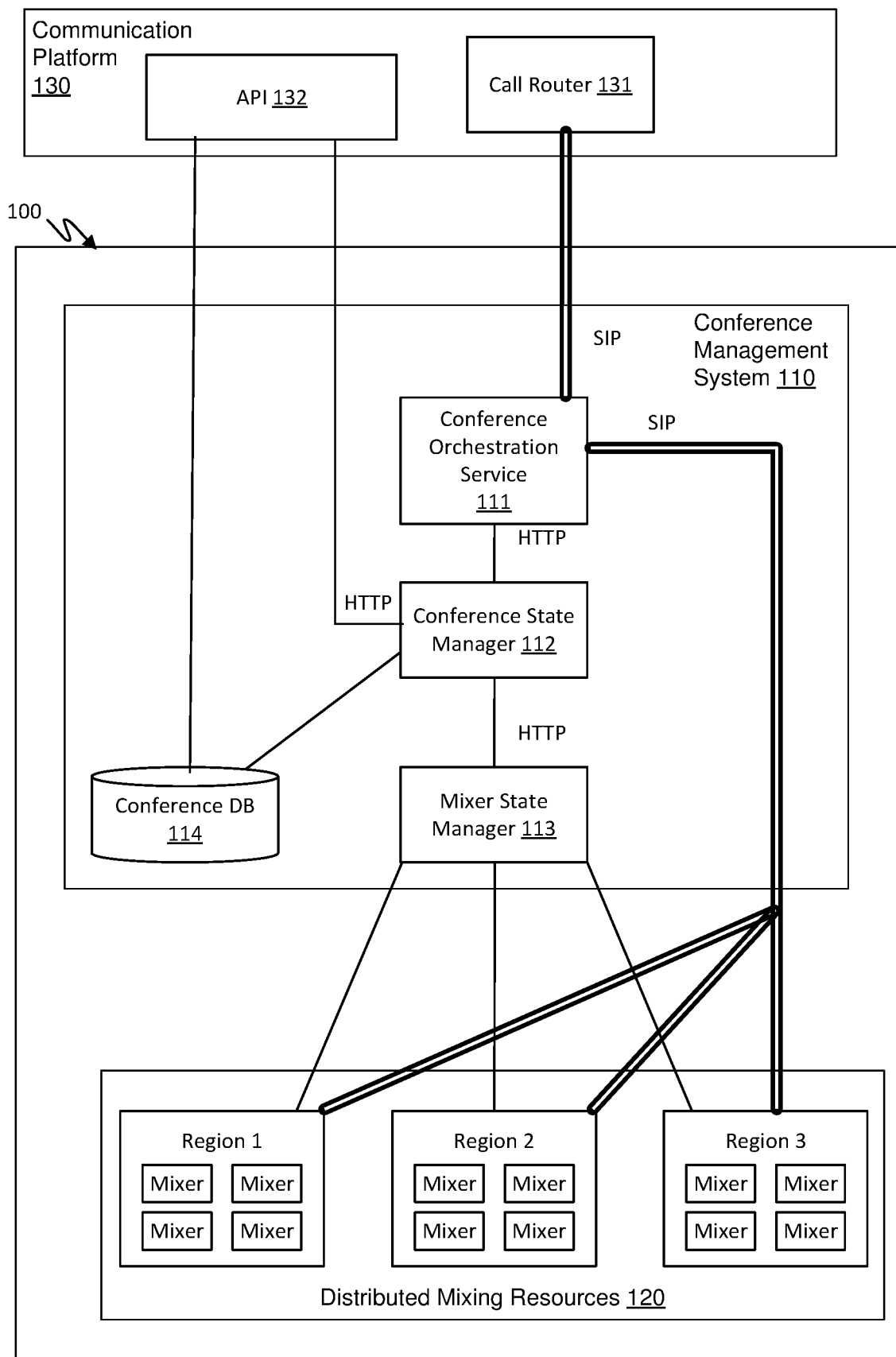


FIGURE 1



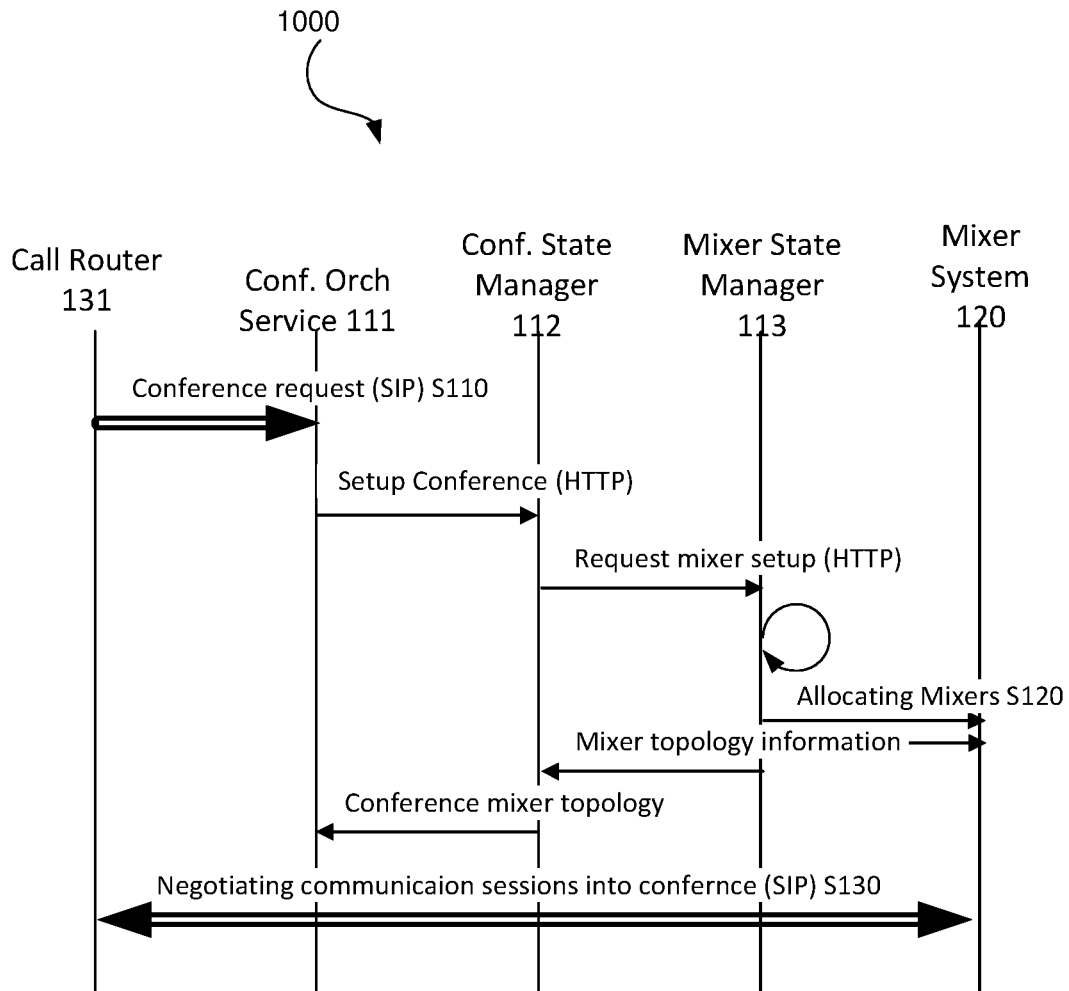


FIGURE 2

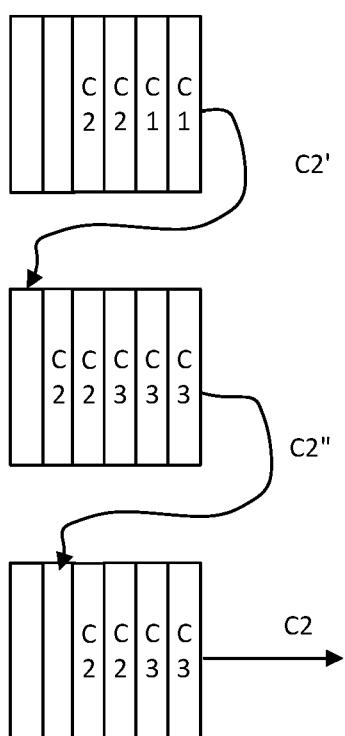


FIGURE 3

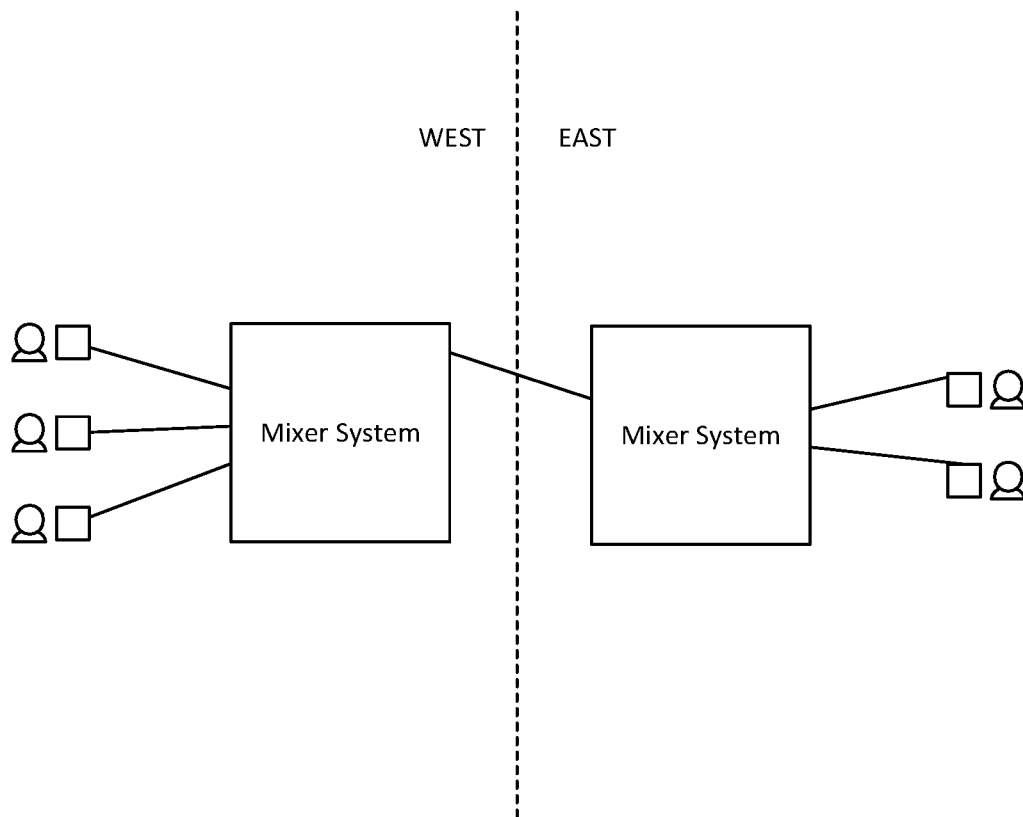


FIGURE 4

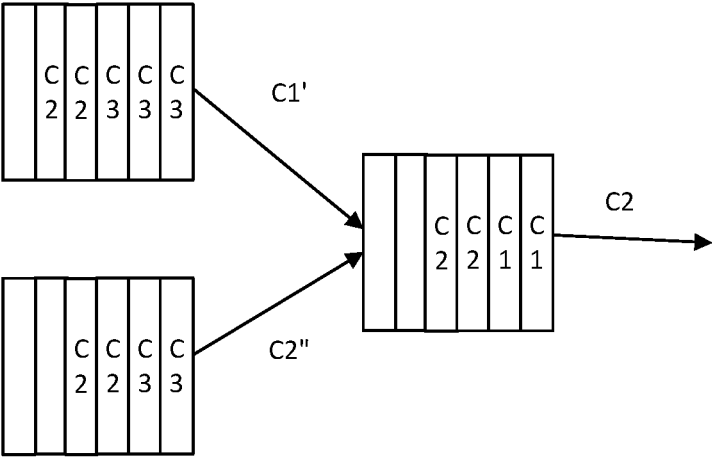


FIGURE 5

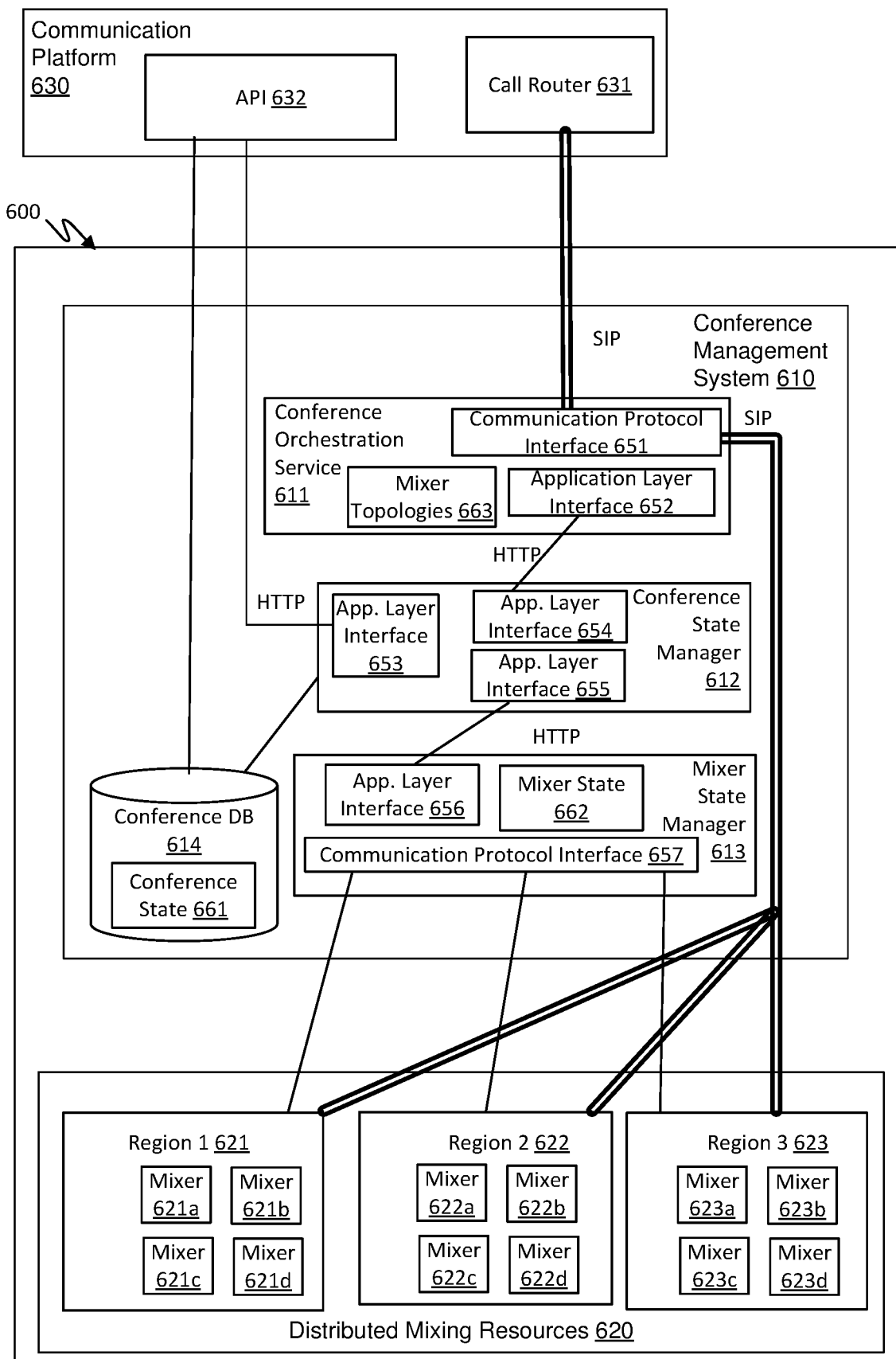


FIGURE 6

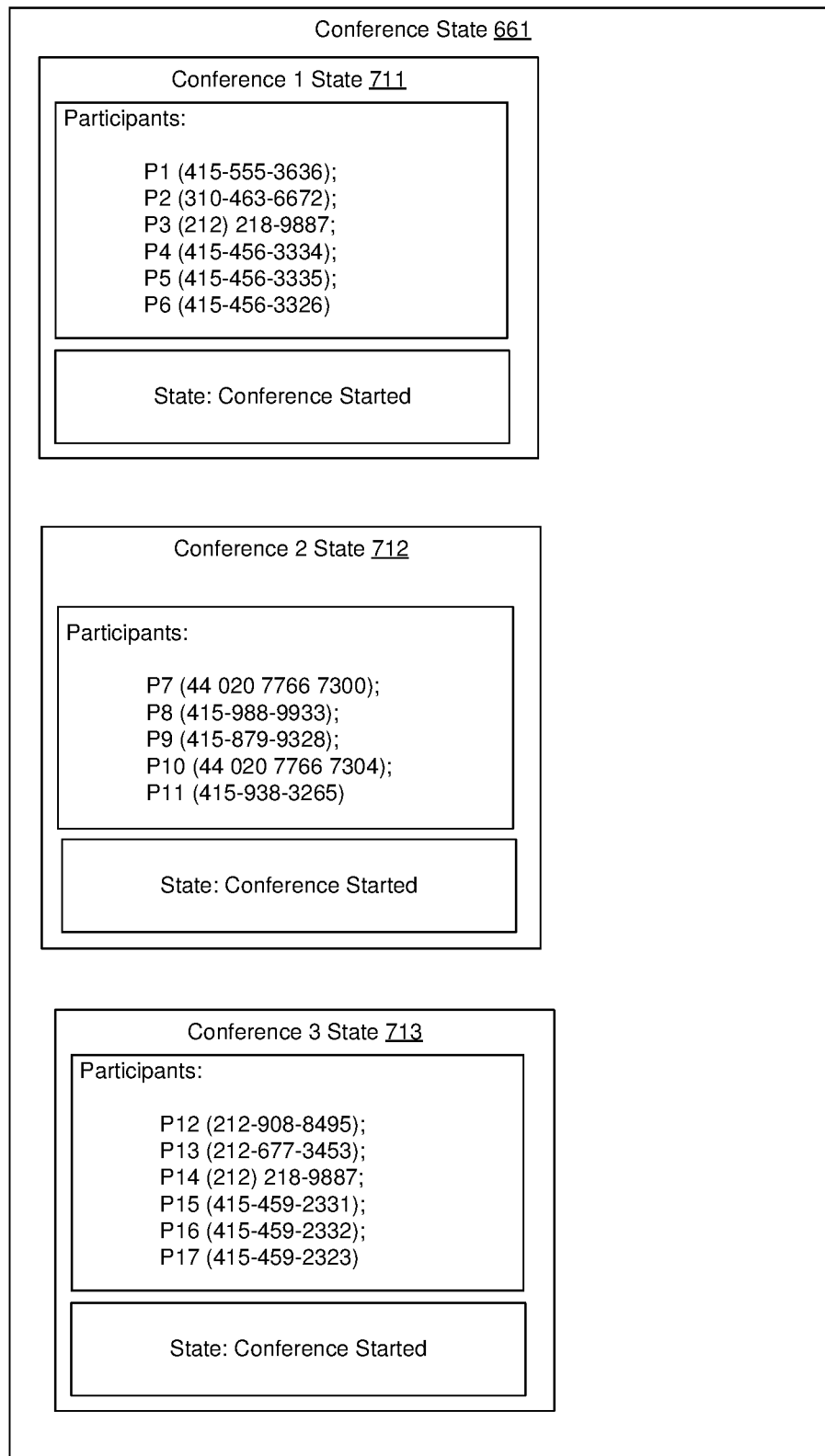




FIGURE 7


662 

Mixer ID	Region	Channel IDs of Free Channels	Channel IDs of Used Channels
621a	1 (California, USA)	1,4	2,3,5,6
621b	1 (California, USA)	4	1,2,3,5,6
621c	1 (California, USA)	1,5,6	2,3,4
621d	1 (California, USA)	1,5,6	2,3,4
622a	2 (Virginia, USA)	1,2,3,4,5,6	
622b	2 (Virginia, USA)	1,2,3,4,5,6	
622c	2 (Virginia, USA)	1,2,3,4,5,6	
622d	2 (Virginia, USA)	5,6	1,2,3,4
623a	3 (London, England)	1,5,6	2,3,4
623b	3 (London, England)	1,2,3,4,5,6	
623c	3 (London, England)	1,2,3,4,5,6	
623d	3 (London, England)	1,2,3,4,5,6	


FIGURE 8

Mixer Topology Conference 1 910


Media Source (e.g., Participant, Mixer)	Mixer ID	Mixer Channel ID
P1 (415-555-3636)	621a	2
P2 (310-463-6672)	621a	3
P3 (212) 218-9887	621b	2
P4 (415-456-3334)	621b	3
P5 (415-456-3335)	621c	3
P6 (415-456-3326)	621c	4
Output of Mixer 621a	621b	1
Output of Mixer 621b	621c	2

**Mixer Topology Output:** Output of Mixer 621cMixer Topology Conference 2 920


Media Source (e.g., Participant, Mixer)	Mixer ID	Mixer Channel ID
P7 (44 020 7766 7300)	623a	3
P8 (415-988-9933)	621d	2
P9 (415-879-9328)	621d	3
P10 (44 020 7766 7304)	623a	4
P11 (415-938-3265)	621d	4
Output of Mixer 621d	623a	2

**Mixer Topology Output:** Output of Mixer 623aMixer Topology Conference 3 930


Media Source (e.g., Participant, Mixer)	Mixer ID	Mixer Channel ID
P12 (212-908-8495)	621a	5
P13 (212-677-3453)	621a	6
P14 (212) 218-9887	621b	5
P15 (415-459-2331)	621b	6
P16 (415-459-2332)	622d	3
P17 (415-459-2323)	622d	4
Output of Mixer 621a	622d	1
Output of Mixer 621b	622d	2

**Mixer Topology Output:** Output of Mixer 622d

FIGURE 9A



Mixer Topology of Conference 1

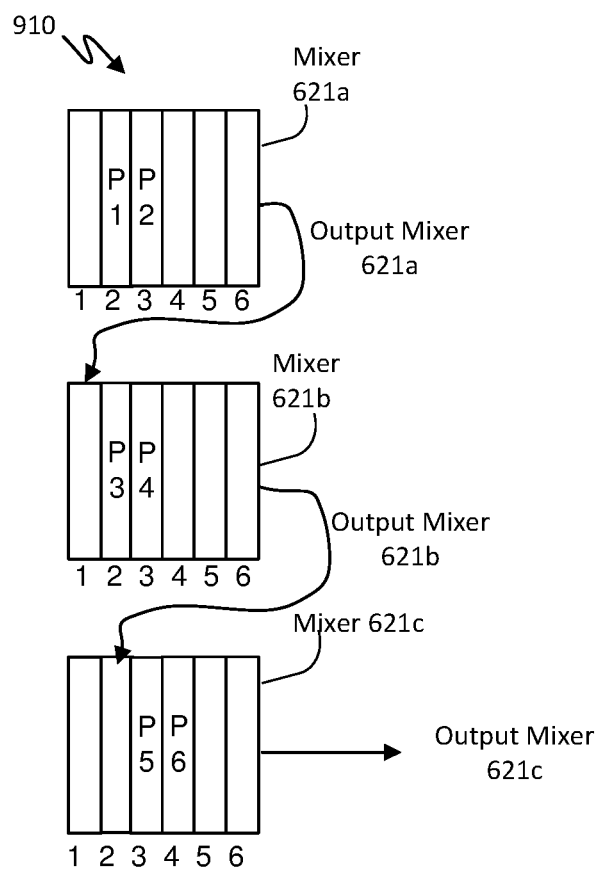


FIGURE 9B

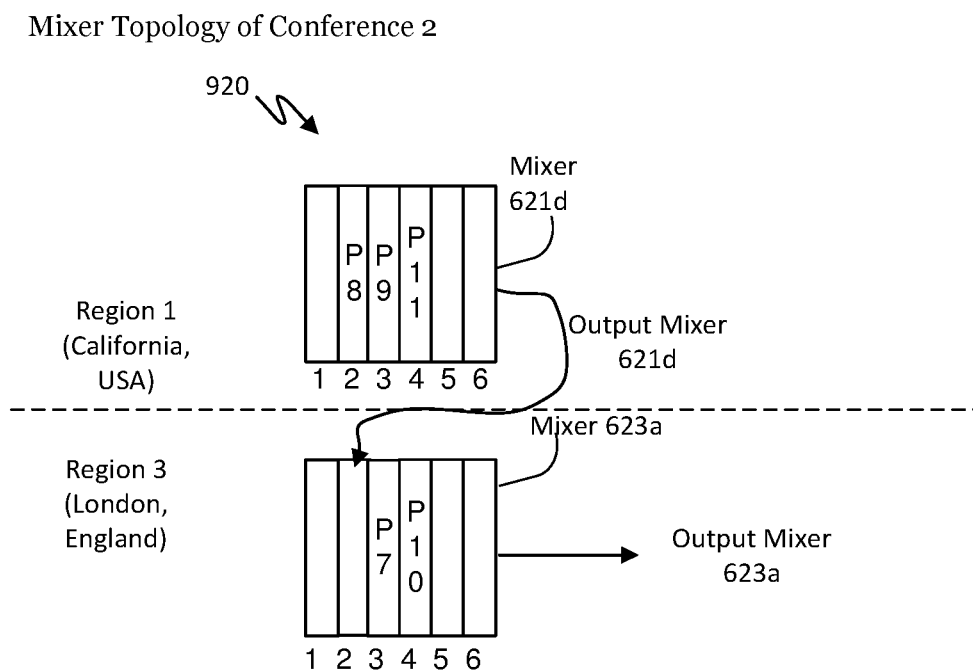


FIGURE 9C

Mixer Topology of Conference 3

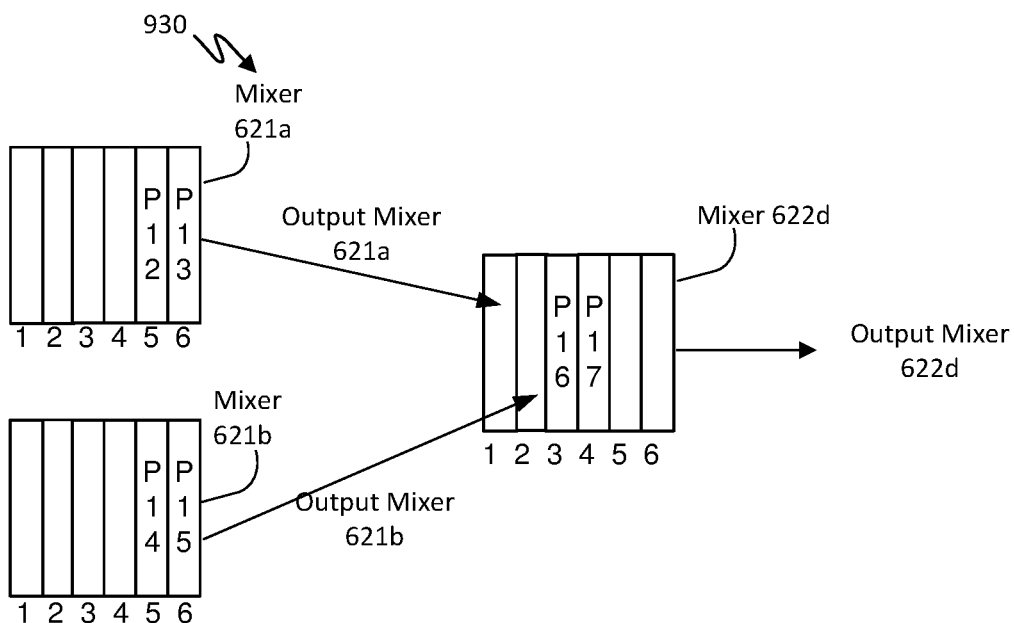


FIGURE 9D

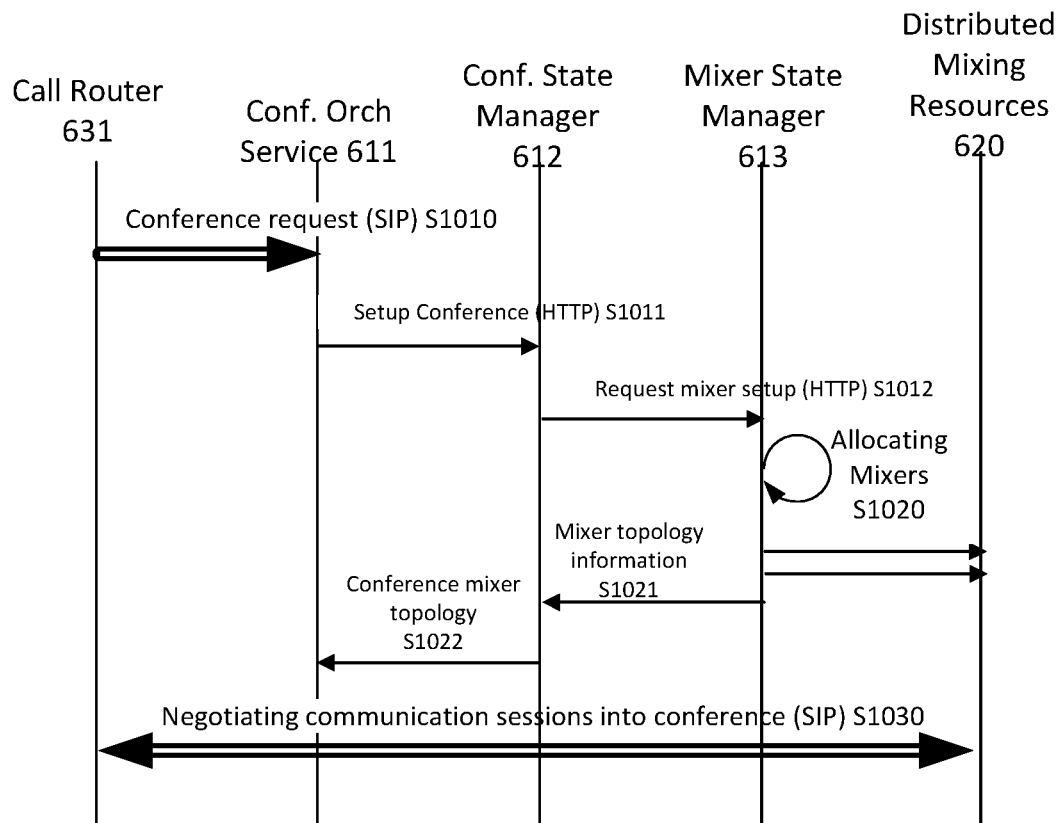


FIGURE 10

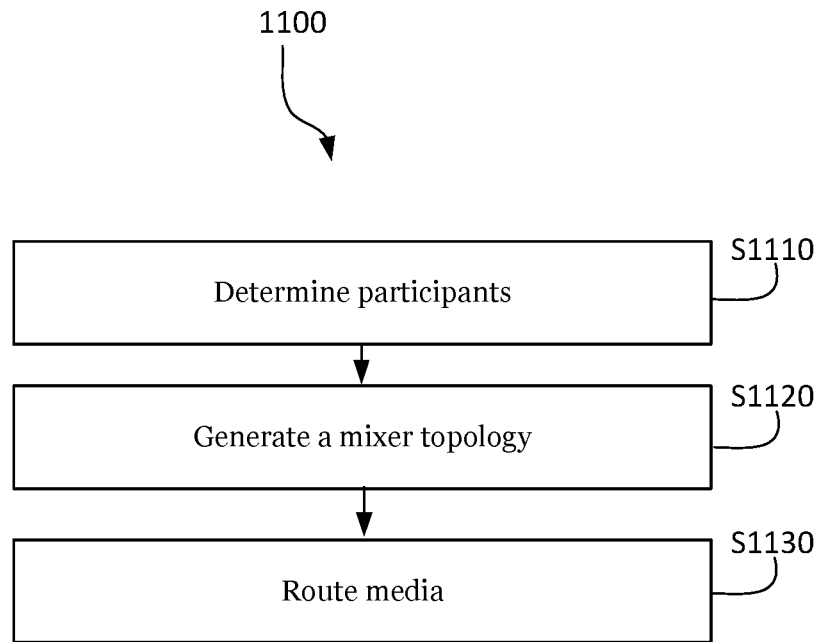


FIGURE 11

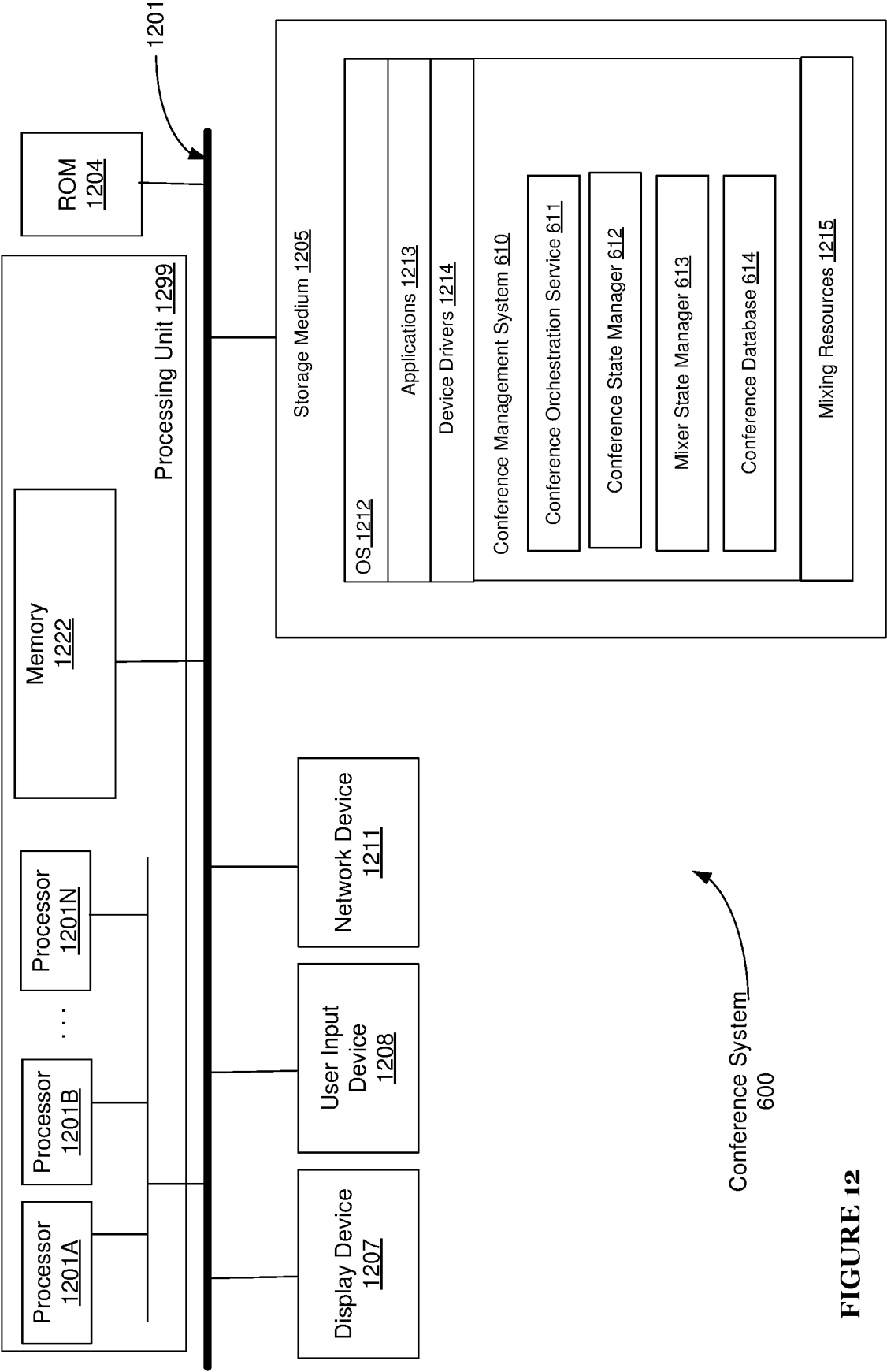


FIGURE 12

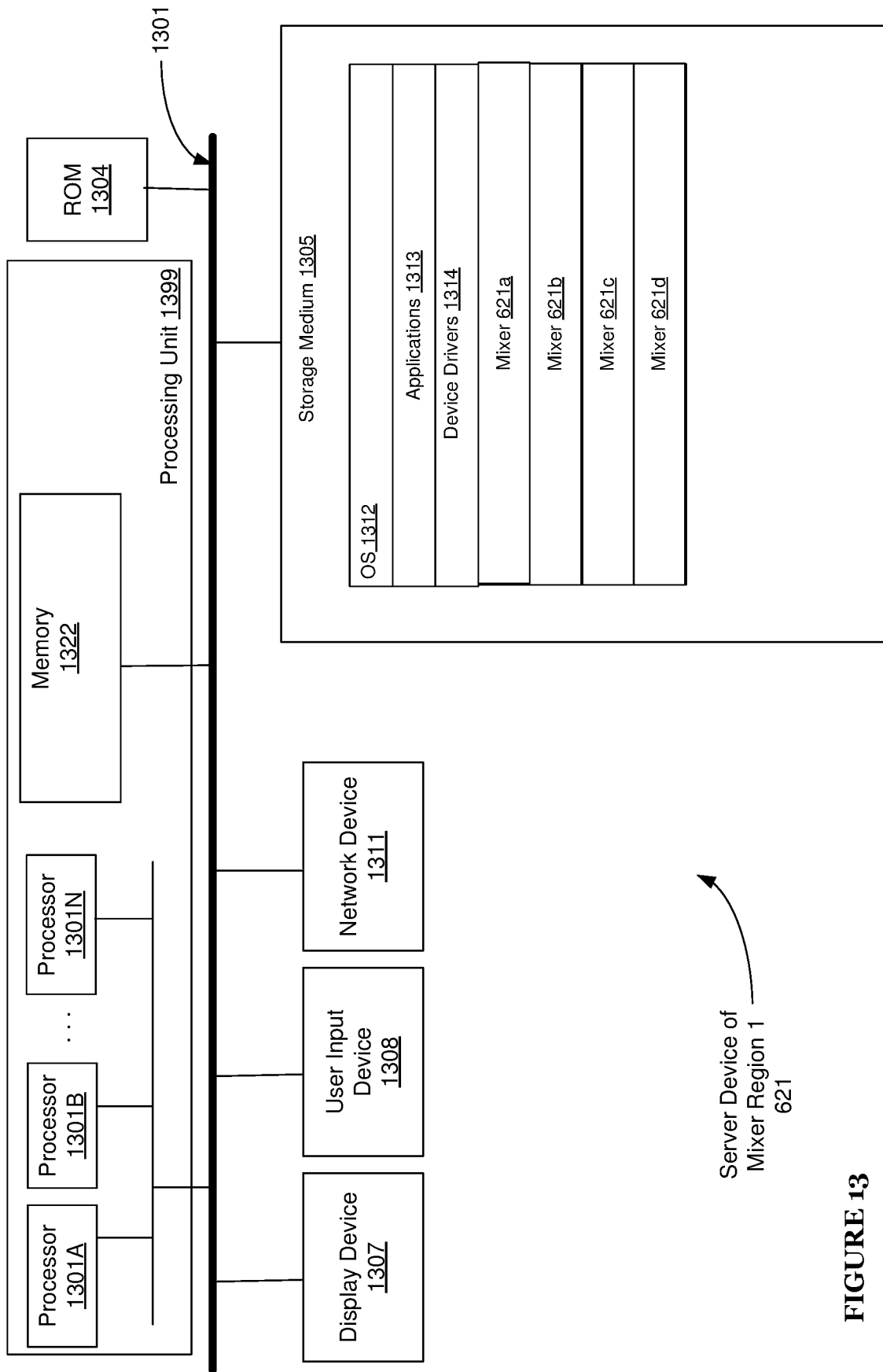


FIGURE 13

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# SYSTEM AND METHOD FOR MANAGING CONFERENCING IN A DISTRIBUTED COMMUNICATION NETWORK

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/964,266, filed 9 Dec. 2015, which is a continuation of U.S. patent application Ser. No. 14/791,759, filed 6 Jul. 2015, which claims the benefit of U.S. Provisional Application Ser. No. 62/021,641, filed on 7 Jul. 2014, all of which are incorporated in their entirety by this reference.

## TECHNICAL FIELD

This invention relates generally to the telephony field, and more specifically to a new and useful system and method for managing conferencing in a distributed communication network.

## BACKGROUND

In recent years, innovations in web application and Voice over Internet Protocol (VOIP) have brought about considerable changes to the capabilities offered through traditional phone and communication services. In some distributed or cloud-based telephony systems, the routing of audio, video, or other media files can be determined or limited by the location and/or availability of the appropriate computing resources. In the case of conference calls, the size of the conference, the quality of the media communication, and capability to support all regions can be limited and can be resource prohibitive. In some cases, conferencing systems are replicated in different regions. But such solutions do not solve inter-regional communication issues, and further creates division in infrastructure, which can complicate maintenance and further improvement. Thus, there is a need in the telephony field to create a new and useful system and method for managing conferencing in a distributed communication network. This invention provides such a new and useful system and method.

## BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is schematic representation of a system of a preferred embodiment;

FIG. 2 is a communication sequence diagram of a method of a preferred embodiment;

FIG. 3 is a schematic representation of a variation distributing participants across a series of mixers;

FIG. 4 is a schematic representation of a variation of regionally mixing media;

FIG. 5 is a schematic representation of a variation mixing participants through a hierarchical mixer configuration;

FIG. 6 is schematic representation of a system of a preferred embodiment;

FIG. 7 is a diagram that depicts exemplary conference state;

FIG. 8 is a diagram that depicts exemplary mixer state;

FIGS. 9A-D are diagrams that depict exemplary mixer topologies;

FIG. 10 is a communication sequence diagram of a method of a preferred embodiment;

FIG. 11 is a process block diagram of a method of a preferred embodiment;

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FIG. 12 is an architecture diagram of conference system of a preferred embodiment; and

FIG. 13 is an architecture diagram of mixer system of a preferred embodiment.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description of preferred embodiments of the invention is not intended to limit the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

### 1. SYSTEM FOR OPERATING SCALABLE CONFERENCING SERVICES

As shown in FIG. 1, a system **100** for operating scalable conferencing services of a preferred embodiment can include a conference management system **110** and a set of distributed mixing resources **120**. The conference management system preferably **110** includes a conferencing orchestration service **111**, a conference state manager **112**, and a mixer state manager **113**. The system **100** functions to provide a high quality conferencing system. The system **100** preferably additionally provides regional accessibility, scalability, and efficiency. The system **100** is preferably architected such that communication quality and performance can be high across a wide range of regional areas. The scalability preferably enables the system **100** to scale out to a large number of participants spanning multiple mixer instances as well as supporting multiple distinct conferences. The system **100** efficiency preferably achieves resource usage that can be substantially proportional to the number of participants.

The system **100** is preferably applied in a communication platform (e.g., the communicating platform **130** of FIG. 1). In one implementation, the system **100** is preferably applied in a communication application platform such as the one described in U.S. Pat. No. 8,306,021 Issued on 6 Nov. 2012, which is hereby incorporated in its entirety by this reference. A communication application platform can execute business logic during a communication session such that a communication state can be directed by application logic and/or API requests. The system **100** is preferably used for synchronous media communication such as voice communication. Voice communication may include communication legs over PSTN, SIP, WebRTC, over the top proprietary IP communications, and/or any suitable communication protocol. Other forms of media such as video may additionally be supplemented or executed using substantially similar systems. For example, audio channels of a video communication session may use the system while individual video media channels are individually routed. In another variation, video may be composited and “mixed” into a single media stream in a manner similar to the audio. Within the communication platform, the communication is preferably divided into media and signaling, and a single communication protocol, such as SIP, may be used for a consistent transport protocol of the signaling within the platform. Other communication protocols may be connected on the edge of the platform or at any suitable location.

In media and signaling protocols, such as SIP, the signaling portion of the communication preferably contributes control directives and a mechanism to communicate various aspects concerning a communication session, and the media portion of the communication is preferably the channel through which media is transferred. The media portion can be particularly susceptible to latency issues caused by the



routing path. The signaling route and the media route can diverge in their network topology.

The conference management system **110** preferably functions to control state of the conferencing system **100**. As one aspect of the system **100**, the system **100** is preferably distributed across multiple regional infrastructure systems. Having a physical system presence in different areas can promote higher quality communications. The management is preferably centralized to a single set of resources, but may alternatively be replicated in other regional instances. As mentioned above, the conference management system **110** preferably includes a conferencing orchestration service **111**, a conference state manager **112**, and a mixer state manager **113**. The communication platform may provide other services that function to establish individual communication sessions, which may be connected in or transitioned to a conferencing state at least partially handled by the system **100**. For example a call router (e.g., **131** of FIG. 1) may facilitate handing incoming calls, making outgoing calls, and controlling communication state (e.g., state as directed by a communication application).

The conferencing orchestration service **111** of the preferred embodiment functions to orchestrate the conferencing service on a signaling level. The conferencing orchestration service **111** preferably maintains a communication session model of the conference. The conference orchestration service preferably maintains the signaling dialog with communication services (e.g., the call router **131** of FIG. 1) of the communication platform (e.g., **130** of FIG. 1). Requests for a new conference are preferably sent to and established through the conferencing orchestration service **111**. The conferencing orchestration service **111** preferably has a media/signaling protocol communication interface with the call router (e.g., **131**) or other suitable communication services of the communication platform (e.g., **130**). In one preferred implementation, the conference orchestration service **111** maintains a SIP dialog with a call router (e.g., **131**) and through a back-to-back user agent (B2BUA) mechanism, redirects the back leg of a communication to either the call router (e.g., **131**) or to a mixer channel (e.g., a mixer channel of the distributed mixing resources **120**). Redirecting to a call router (e.g., **131**) may be used to put a communication session into a wait-state by playing a wait song or processing any suitable wait-state application. The conferencing orchestration service **111** is preferably fronted by load balancing mechanism such that any new incoming requests (e.g., SIP INVITES) are distributed to a new server using a round-robin policy.

Individual nodes in the conferencing orchestration service **111** can additionally include an API that enables the conference state manager **112** to notify the conference orchestration service **111** of state changes. For example, notifications such as "conference starting—please dial in" or "conference ending" or "participant joining/leaving" may be sent through the API. The API is preferably an internal REST API but any suitable API may alternatively be used. The conferencing orchestration service **111** preferably delegates management of conference state to the conference state manager **112**. The conference state manager **112** can then direct the conferencing orchestration service **111** to negotiate media with assigned mixers (e.g., mixers of the distributed mixing resources **120**).

The conference state manager **112** of the preferred embodiment functions to manage the state of the conferences in a highly available manner. The state of conferences is preferably global across multiple communication platform regions. The conference state may reference conference

participants and mixers in different regions. The conference state manager **112** preferably maintains an application model of a conference. The conference state **112** manager preferably stores a data object representation of a conference. The data model of a conference may include a list of participants, duration of the conference, and state of the conference (e.g., waiting for participants, in session, completed, and the like). The conference state manager preferably **112** includes an interface to an Application Program Interface (API) (e.g., the API **132**) of the communication platform (e.g., **130**), which may be an access point for programmatically inspecting and/or modifying the state of a conference. The conference state manager **112** preferably includes application layer communication interfaces to the API (e.g., **132**), the conference orchestration service **111**, and the mixer state manager **113**. The application layer communication interfaces preferably use HTTP/S, but may alternatively use any suitable application layer protocol. The conference state manager **112** can relay changes in state of a conference to the conference orchestration service **111**, which can make suitable changes to the managed media services. The conference state manager **112** additionally utilizes the mixer state manager **113** to setup and determine mixer setup for a given conference. The conference state manager **112** may be fronted by a load balancer.

The mixer state manager **113** of the preferred embodiment functions to monitor and control the set of mixer resources (e.g., mixer resources of the distributed mixing resources **120**). The set of mixers may be distributed across multiple regions (e.g., "Region 1", "Region 2", and "Region 3" of FIG. 1), and each regional set of mixers may have various amounts of mixing capacity and number of running instances. Additionally, each mixer may be in different states depending on whether the mixer is serving a conference, multiple conferences, or idle. The mixer state manager **113** preferably manages a data model of the mixer resources. The mixer state manager **113** may store the mixer state information across a distributed storage system such that access to the information is highly available. As described above, an application layer communication interface preferably exists between the conference state manager **112** and the mixer state manager **113**. The mixer state manager **113** additionally include a communication control protocol interface with the set of mixers (e.g., mixers of the distributing mixing resources **120**), such as SIP or at least some signaling portion of a media and signaling protocol. The mixer state manager **113** is preferably configured to be responsive to requests of the conference state manager **112**. The mixer state manager **113** can provide information about the current state of mixers (e.g., mixers of the distributing mixing resources **120**) and additionally allocate mixers. The mixer state manager **113** can assign participants to particular mixers. The mixer state manager **113** can preferably apply regional and quality based heuristics in assigning mixers. Additionally, the mixer state manager **113** can additionally consider the distribution of participants according to the partitions of a mixer instance. A mixer may fail at times, and the mixer state manager **113** can detect the mixer failure for a conference session, allocate a new mixer, and re-invite participants to recover from the failure.

The set of mixers (e.g., mixers of the distributing mixing resources **120**) of the preferred embodiment functions to provide a set of resources that can merge, bridge, or otherwise combine media streams to allow multiple legs in a communication. There is preferably a plurality of mixer instances in the set of mixers. The set of mixers may additionally be distributed across distinct regional areas. A

subset of mixers can exist in a first region (e.g., "Region 1" of FIG. 1) and a second subset of mixers can exist in a second region (e.g., "Region 2" of FIG. 1). A region preferably describes distinct computer cluster location where a set of resources of the communication platform is instantiated. For example, a first region may exist on the West coast while a second region exists in the East coast. As media may be sensitive to latency from routing between regions, a set of regional subsystems can facilitate improving communication quality and in particular reducing media latency.

Mixers can preferably be used in isolation for a conference—one mixer facilitates completing mixing for every participant in a conference. Alternatively, mixers may be used in combination to facilitate mixing for all participants. Mixers may be used in series. For example, a first mixer may mix three of the eight participants in a conference, a second mixer may mix another three, and a third may mix two remaining participants. The three mixers are preferably set to be bridged for those partitions so that all eight participants are appropriately mixed. The mixers may be arranged in a hierarchical or network formation. For example, two mixers may mix media streams of participants, and the output media stream from each of these two child mixers can be mixed by a parent mixer. Such mixing architecture can be used to flexibly use the capacity of the mixing resources.

The system (e.g., 100) of the preferred embodiment is preferably operable in at least two regions, which are connectable through the media resources of the system. Various provider services in the regions can facilitate connecting media streams to outside endpoints (e.g., PSTN phones, SIP phones, or IP communication devices). The regions are preferably selected to serve endpoints local to that region. The regions may be separated by globally significant distance. A globally significant distance in this document may be understood to be a transmission distance greater than 2000 miles and more preferably greater than 5000 miles. For example, the first region may be on the West coast of the US and the second region may be on the East coast, separated by a geographic distance greater than 2500 miles. In another example, the first region may be in the United States and the second region may be in Europe, separated by a distance greater than 3500 miles. The first region and the second region are not limited to functioning with such distance ranges and may be separated by a distance less than 2000 miles or exceeding 5000 miles.

A mixer (e.g., a mixer of mixing resources 120) of a preferred embodiment functions to mix or combine at least two sources of synchronous communication. In particular, audio media streams are combined into a single audio stream. A mixer is preferably a service that includes a communication interface and processing capabilities. In one preferred implementation, the communication interface is an SIP interface, which may be used in interfacing with the communication orchestration service 111, other mixers in the same region, mixers in other regions, and/or other communication resources such as recording services, and communication gateways (which may connect to destination endpoints).

The mixer may have a participant input capacity, which limits the number of participants that can be mixed. The mixer preferably includes a number of participant input channels. For example, a mixer may be able to handle up to 500 participants. The number of participant input channels can additionally be distributed across distinct conference sessions, such that one mixer instance can serve multiple conferences. A mixer preferably outputs mixed media, which may be directed to endpoint connections and/or other

mixers. A mixer preferably has an identifier such that media can be directed to specific mixers as assigned by the mixer state manager 113. Various other capabilities may be built into a mixer. The mixers may additionally include media mixing capability that allows a manager to listen to a participant leg (i.e., the manager is a silent participant). Additionally, the mixer may include mixing capability to segment portions of audio to subset of participants. For example, one participant may be able to privately converse with one other participant without other participants hearing their conversation.

The system (e.g., 100) can include resources or functionality modules that can provide recording, transcription, text-to-speech services, DTMF input, speaker identification service (e.g., which participant is speaking when), or any suitable media service.

## 2. METHOD FOR OPERATING SCALABLE CONFERENCING SERVICES

As shown in FIG. 2, a method for operating scalable conferencing services of a preferred embodiment can include receiving a request for a new conference S110, allocating mixers of the conference S120, and negotiating media across the allocated mixers S130. More specifically, a mixer topology is created according to regional associations and restrictions. Then when negotiating media across the allocated mixers, participants are allocated to input channels of a mixer and mixers are bridged to form a determined mixer topology.

The method functions to provide a high quality conferencing service. The method may additionally promote regional accessibility, scalability, and efficiency. The scalability preferably enables the method to facilitate conferences with a large number of participants, spanning multiple mixer instances, as well as supporting multiple distinct conferences. The system efficiency preferably achieves resource usage that can be substantially proportional to the number of participants. The method is preferably implemented by the system (e.g., 100) described above, but may alternatively be implemented by any suitable system.

The method may be applied in a variety of conferencing scenarios. The method preferably accounts for different scaling and allocation scenarios so as to provide high capacity and high quality conferencing. The method can be used in conferencing scenarios such as when the participants are geographically distributed, where the conference is not started until all participants join, where a conference can organically grow without a priori knowledge of the identity or number of participants, and other suitable scenarios.

Block S110, which includes receiving a request for a new conference, functions to receive some directive to create a conference. The request can be part of an asynchronous API request. The request may alternatively be a response to the routing of communication. For example, a communication session may hit a conference orchestration service (e.g., 111 of FIG. 1) and be placed in a conference. While an endpoint and corresponding communication session is waiting to join a conference session, the communication session may be directed to a wait-state application which can play music, execute an application, or perform any suitable application logic. The communication session is preferably transferred into an active communication session during block S130.

Block S110, preferably includes determining participants of the conference. Participants may be present on an existing or otherwise established communication session. For example, a caller may be transferred into a conference. As

another example, a caller may dial in to a phone number or other suitable endpoint, which is mapped to a particular conference. A conference state manager (e.g., 112 of FIG. 1) preferably manages the conference participants. In one case, participants may be specified through an API (e.g., the API 132 of FIG. 1). The API calls are preferably directed to the conference state manager (e.g., 112) such that state can be updated. In some cases, a participant may not be present in an active communication session. The method can include making an outgoing communication request to establish a communication session with the missing participant such that the participant can be added to a conference. In some cases, the conference waits for some initiating condition such as a conference start time, threshold number of participants, or any suitable condition. In other cases, a conference session can begin as soon as the conference is created.

In addition to determining participants, the method preferably includes determining participant regions. The conferencing infrastructure may be distributed across various regions. Geographic proximity to a region may improve communication quality. The regions associated with a participant may be completed through processing an endpoint. In some cases, endpoints (such as telephone numbers) will include location-overloaded information (e.g., country/area codes). Alternatively, location information may be collected and obtained through any suitable method or source.

Block S120, which includes allocating mixers (e.g., mixers of the distributed mixing resources 120 of FIG. 1) of the conference, functions to setup mixers to handle the conference session. Allocating mixers preferably includes determining which mixers, and specifically which participant will be assigned to which input channel of a mixer. Additionally, a multi-mixer topology can be created which defines bridging of media between mixers. The mixer state manager 113 preferably stores state of the set of mixers. Mixers may be in different states of usage. In some cases allocating mixers may involve adding mixers in one or more regions. Mixers can additionally be removed from the set of mixers. As another variation, allocating mixers can involve transitioning an existing conference in response to the mixing requirements introduced. Such responsive changes to conference mixing function to improve overall communication quality across multiple conferences.

Allocating mixers (block S120) preferably includes processing the information related to the conference and generating a mixer topology. Generating a mixer topology preferably calculates an arrangement/architecture to mixer assignment and bridging so as to obtain high quality communication. The mixer topology preferably characterizes and identifies how the media from participants is mixed to form a conferencing experience. With the mixer resources described above, a participant is preferably mapped to one particular media input channel. The mixer topology can be generated according to some operational goal. Preferably the goal is communication quality. High quality communication is preferably a function of communication latency, which is preferably minimized or reduced. Other properties that may additionally or alternatively be factored into the evaluation function of communication quality can include packet loss, post dial delay (PDD) (i.e., time for carrier to indicate the other side is ringing), monetary cost to the platform provider, monetary price charged to account holder, media quality, and/or any suitable factor. Generating a mixer topology can additionally account for mixer capacity. Additionally, how multiple mixers can be bridged may additionally be determined.

The mixer topology can consider various factors and may include heuristics for particular scenarios. In one variation, block S120 can include grouping participants into mixer input channels according to regional association. More specifically, the orchestration of mixers may be such that the conference achieves local media communication quality. In other words, participants local to other participants experience improved communication quality. For example, if a conference exists by a group of 3 participants in the West coast and 4 in the East coast, then a set of mixers in a Western region handle the first set of participants and a set of mixers in the Eastern region handle locally conferencing the second set of participants. Communication quality may be of lower quality between the participants in the two regions, but conferencing between the local participants may have high quality communication.

In another variation, block S120 can include grouping participants into mixer partitions by participant priority. Participants may be marked by different priority. The priority may be based on who organized the meeting, the role in the conference, or any suitable property. For example, a massive conference may have a host/moderator, a panel (who will contribute to the discussion), and then audience members who may be silent participants but may be allowed to ask questions at times. Mixing topology generation can weigh the priority of participants when calculating conference quality. For example, participants that will primarily be listening may not have a high demand for low latency communication, and so the mixer topology may not optimize for minimizing media latency for these participants.

Block S130, which includes negotiating routing media of the set of communication sessions to the allocated mixers, functions to route media of participants to assigned mixers and start the conferencing session. Negotiation routing media preferably includes various signaling handshaking between involved media resources and the mixer resources. The media is preferably routed according to the mixer topology which can include routing media of participants to assigned mixer input channel and bridging mixed media across mixer instances. As described above, SIP or an alternative media and signaling protocol may be used in directing participant communication sessions from a conference orchestration service 111 to mixers. In particular, the media of the participant communication session is routed to a mixer. Intermediary nodes may be used in the routing to mixer. For example, regional gateway proxy servers may be used when routing media or signaling to outside regions. Within a mixer, the set of participant input channels for a conference are mixed or combined through any suitable processing. The output of the mixing can be bridged to another mixer for further mixing or redirected to a connected endpoint.

Negotiating the routing of media preferably establishes various mixer scenarios. In a first variation, the participants may be serviced by a single mixer. A single mixer may be used when all participants have relatively close proximity to the mixer, and a mixer has capacity to handle the number of participants.

In other instances, multiple mixers may be used. In one use-case, a single mixer may not have capacity for a conference, and so the participants are distributed across multiple mixers as shown in FIG. 3. In another use-case, multiple mixers may be used so as to give a subset of participants regional mixing within the conference as shown in FIG. 4. The mixers preferably bridge over to other mixers such that a mixer output channel is mixed as an input to a second mixer.

In yet another instance, mixers may be used in a hierarchical mixing. In hierarchical mixing a mixer mixes output channels of at least two mixers as shown in FIG. 5. Participant input channels can additionally be mixed simultaneously with hierarchical mixing.

Once negotiated, a conference session can take place, and participants can communicate as a group. Various features may additionally be supported during a conference.

A conference is preferably exposed as an accessible API resource, and as such, the conference can preferably be manipulated through various directives. The state of the conference can be queried. Information such as conference status (e.g., waiting, started, ended), participant count, participant identification, conference duration, an event log of the conference (e.g., when people joined/left, who spoken when, etc.), and other suitable pieces of information can be supplied in an API response. Additionally the conference may be augmented. API calls directed at a particular conference may add or remove participants, mute participants, set up individually directed media control, split a conference into multiple conferences, join a conference with another conference, end the conference, and/or make any suitable change.

A method can additionally include individually directing the media flow of one or more participants. With individual media control in addition to the group mixing, participants may be able to listen in on a second participant. As an exemplary use case, a manager may want the capability to listen in on a participant's leg of the conference. As another variation, a participant may want the capability to transfer media to only a subset of participants. For example, during a conference, a first participant may want to say something to a second participant without the other participants hearing what is said. As another example, the first participant may want to say something to a larger subset of participants (e.g., two or more people) without the rest hearing.

Event callbacks can additionally be configured for the conference. An event callback is preferably a mapping between an event and a designated callback destination such as an URI or other resource that is accessed when the event is detected. A callback destination may also be a pre-established application session using web-sockets or some other similar mechanism. In particular, a speaker callback, may be triggered when a speaker changes in the conference. For example, an application that setup the conference may set a speaker callback URI. When a speaker changes in the conference, an HTTP messages is sent to the speaker callback URI. The message preferably identifies the new speaker and optionally the time of the change and the last speaker. Another callback may be for communication input. In telephony conferences, participants may be able to provide input through DTMF input. An input callback will preferably hit the input callback resource with information about input (e.g., who entered what key when). Other callbacks can include when the conference starts, when the conference ends, when there is a change in the participants (e.g., a new one joins or leaves), or any suitable event.

The method can additionally include transitioning mixer topology, which functions to adapt negotiated mixer topology according to new conditions. Participants can join and leave during a conference, and as such the preferred mixer topology can change. The transition can be in response to any number of triggers. In one variation, the mixer topology may be re-evaluated and possibly transitioned each time there is a change in participants. This may provide high quality communication throughout a conference. In another variation, the conference may be re-evaluated periodically,

which may avoid overhead of frequent transitions but allow communication to be eventually transitioned to a preferred state. In another variation, the transitioning may be re-evaluated and initiated in response to a trigger. For example, a user input may signal that the communication quality is lacking, and should be refreshed to improve quality. Other variations may include variations more directed at changes in regional mixing, or the number of participant changes, total number of participants, and other factors.

The method described above was directed towards a single conference instance, but the system and method is preferably used in situations where multiple conferences are facilitated simultaneously. More preferably, the method is used to service the conferencing features of a multi-tenant communication platform. The selection of mixers additionally considers the usage of mixers across multiple mixers.

### 3. CONFERENCE SYSTEM

As shown in FIG. 6, a conference system 600, in accordance with an embodiment, includes a conference management system 610 and distributed mixing resources 620. In some implementations, the conference management system 610 includes a conference orchestration service 611, a conference state manager 612, a mixer state manager 613, and a conference database 614.

In some implementations, the conference management system 610 is similar to the conference management system 110 of FIG. 1. In some implementations, the distributed mixing resources 620 is similar to the distributed mixing resources 120 of FIG. 1. In some implementations, the conference orchestration service 611 is similar to the conference orchestration service 111 of FIG. 1. In some implementations, the conference state manager 612 is similar to the conference state manager 112 of FIG. 1. In some implementations, the mixer state manager 613 is similar to the mixer state manager 113 of FIG. 1. In some implementations, the conference database 614 is similar to the conference database 114 of FIG. 1.

In some implementations each mixer (e.g., 621a-d, 622a-d, 623a-d) is a mixer system. In some implementations each mixer system is a server device (e.g., a server device similar to the server device of FIG. 13). In some implementations the mixers (e.g., 621a-d, 622a-d, 623a-d) are included in a server device. In some implementations the mixers are included in a plurality of server devices. In some implementations, each mixer (e.g., 621a-d, 622a-d, 623a-d) includes at least one processing unit (e.g., a processing unit similar to the processing units described below for FIG. 13, such as, for example, the processing unit 1399). In some implementations, mixers in a same region are included in a same server device. For example, the mixers 621a-d are included in a first server device located in Region 1 (e.g., California, USA), the mixers 622a-d are included in a second server device located in Region 2 (e.g., Virginia, USA), and the mixers 623a-d are included in a third server device located in Region 3 (e.g., London, England). In some implementations, mixers in a same region are included in a same computing cluster (e.g., a computing cluster that includes a plurality of computing devices, such as, for example, a server device similar to the server device of FIG. 13). For example, the mixers 621a-d are included in a first computing cluster located in Region 1 (e.g., California, USA), the mixers 622a-d are included in a second computing cluster located in Region 2 (e.g., Virginia, USA), and the mixers 623a-d are included in a third computing cluster located in Region 3 (e.g., London, England). In some implementations,

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each server device includes at least one processing unit (e.g., a processing unit similar to the processing units described below for FIG. 13, such as, for example, the processing unit 1399).

In some implementations, the conference management system 610 is included in a server device (e.g., the server device of FIG. 12). In some implementations, the conference management system 610 is included in a server device (e.g., the server device of FIG. 12), and the conference management system 610 includes at least one mixer (e.g., at least one of the mixers 621a-d, 622a-d, 623a-d). In some implementations, the conference management system 610 is included in a server device (e.g., the server device of FIG. 12), and the conference management system 610 includes mixers of at least one region (e.g., mixers of at least one of "Region 1", "Region 2", and "Region 3" of FIG. 6).

In some implementations, the conference management system 610 is a distributed system that includes a plurality of server devices. In some implementations, the conference management system 610 includes at least one mixer (e.g., at least one of the mixers 621a-d, 622a-d, 623a-d). In some implementations, the conference management system 610 includes mixers of at least one region (e.g., mixers of at least one of "Region 1", "Region 2", and "Region 3" of FIG. 6).

In some implementations, each of the regions of the distributed mixing resources 620 (e.g., "Region 1", "Region 2", and "Region 3") are communicatively coupled via media resources of the system 600. In some implementations, various provider services in the regions facilitate coupling media streams to outside endpoints (e.g., PSTN phones, SIP phones, or IP communication devices). In some implementations, the regions are selected to serve endpoints local to that region. In some implementations, the regions are separated by a globally significant distance. In some implementations, a globally significant distance is a transmission distance greater than 2000 miles. In some implementations, a globally significant distance is a transmission distance greater than 5000 miles. In some implementations, for example, a first region may be on the West coast of the US (e.g., California, USA) and a second region may be on the East coast (e.g., Virginia, USA), separated by a geographic distance greater than 2500 miles. In some implementations, for example, a first region may be in the United States (e.g., Virginia, USA) and a second region may be in Europe (e.g., London, England), separated by a distance greater than 3500 miles. In some implementations, the first region and the second region are not limited to functioning with such distance ranges and may be separated by a distance less than 2000 miles or exceeding 5000 miles.

In some implementations, the conference orchestration service 611, the conference state manager 612, the mixer state manager 613, and the conference database 614 are included in a single server device (e.g., the server device of FIG. 12). In some implementations, the conference orchestration service 611, the conference state manager 612, the mixer state manager 613, and the conference database 614 are included in a distributed computing system that includes a plurality of server devices, and each server device of the distributed computing system includes one or more of the conference orchestration service 611, the conference state manager 612, the mixer state manager 613, and the conference database 614.

In the embodiment of FIG. 6, the conference system 600 is communicatively coupled to a communication platform 630. In some implementations, the communication platform 630 is similar to the communication platform 130 of FIG. 1. In some implementations, the communication platform 630

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includes an API 632 and a call router 631. In some implementations, the API 632 is similar to the API 132 of FIG. 1. In some implementations, the call router 631 is similar to the call router 131 of FIG. 1.

As shown in FIG. 6, the conference orchestration service 611 is communicatively coupled to the call router 631 via a communication protocol interface 651, and the conference state manager 612 is communicatively coupled to the API 632 via an application layer interface 653. As shown in FIG. 6, the conference database 614 is communicatively coupled with the API 632.

As shown in FIG. 6, the communication protocol interface 651 communicatively couples the conference orchestration service 611 to at least one mixer of the distributed mixing resources 620.

As shown in FIG. 6, an application layer interface 652 communicatively couples the conference orchestration service 611 to an application layer interface 654 of the conference state manager 612.

As shown in FIG. 6, the conference state manager 612 is communicatively coupled to the conference database 614.

As shown in FIG. 6, an application layer interface 655 communicatively couples the conference state manager 612 to an application layer interface 656 of the mixer state manager 613.

As shown in FIG. 6, a communication protocol interface 657 communicatively couples the mixer state manager 613 to at least one mixer of the distributed mixing resources 620.

In some implementations, the communication protocol of at least one of the interfaces 651 and 657 is SIP (Session Initiation Protocol). In some implementations, the application layer interface of at least one of the interfaces 652, 653, 654, 655, and 656 is an HTTP interface.

In some implementations, the conference database 614 includes conference state 661. In some implementations, the conference state manager includes the conference state (e.g., 661). In some implementations, the conference state 661 includes conference state for each conference of the system 600. In some implementations, the conference state for a conference is generated during reception of a request for a new conference. In some implementations, conference state for a conference indicates at least each participant of the conference. In some implementations, conference state for a conference indicates at least an endpoint identifier (e.g., a telephone number) for each participant of the conference.

FIG. 7 depicts exemplary conference state of the conference state 661.

In some implementations, the mixer state manager 613 includes mixer state 662. In some implementations, the mixer state 661 includes mixer state for each mixer of the distributed mixer resources 620 (e.g., the mixers 621a-d, 622a-d, 623a-d) of the system 600. In some implementations, the mixer state for a conference is managed by the mixer state manager 613 during operation of each mixer of the distributed mixer resources 620. In some implementations, mixer state for a mixer indicates at least a status of each channel of the mixer. In some implementations, the status indicates whether the respective channel is in use or not in use. In some implementations, the status indicates that the channel is not in use in a case where the channel is not in use, and indicates at least one of participant identifier and a conference identifier in a case where the channel is assigned to a participant of a conference. In some implementations, a participant identifier is an endpoint identifier (e.g., a telephone number).

FIG. 8 depicts exemplary mixer state of the mixer state 662.

In some implementations, the conference orchestration service **611** includes mixer topologies **663**. In some implementations, the mixer topologies **663** includes a mixer topology for each conference for which at least one mixer is allocated. In some implementations, each mixer topology specifies an assignment of each participant of a respective conference to at least one input channel of a mixer. In some implementations, each assignment of a mixer topology indicates an endpoint identifier (e.g., a telephone number) and a corresponding mixer channel identifier (e.g., a mixer ID and a corresponding mixer channel ID). In some implementations, a mixer topology for a conference identifies a mixer output to be provided to the conference orchestration service **611**. For example, in a case of a mixer topology that includes more than one mixer, the mixer topology indicates the mixer whose output is provided to the conference orchestration service as the output of the mixer topology.

FIGS. 9A-D depict exemplary mixer topologies of the mixer topologies **663**. FIG. 9A depicts exemplary data representations of mixer topologies of Conference 1, Conference 2, and Conference 3 of the exemplary conference state information **661** of FIG. 7. FIG. 9B is a diagram representing the mixer topology of Conference 1 state **711**. FIG. 9C is a diagram representing the mixer topology of Conference 2 state **712**. FIG. 9D is a diagram representing the mixer topology of Conference 3 state **713**.

The exemplary mixer state **662** of FIG. 8 represents the mixer state of the mixers (e.g., of the distributed mixing resources **620**) after allocation of mixer channels in accordance with the mixer topologies of FIGS. 9A-D.

In some implementations, the conference state manager **612** is constructed to maintain conference state (e.g., conference state **661**) of each conference, and to notify the conference orchestration service **611** of conference state changes via the application layer communication interfaces **654** and **652**.

#### 4. METHOD OF FIG. 10

The method **1000** of FIG. 10 includes, at a conferencing system (e.g., **600** of FIG. 6) constructed to operate scalable conferencing services, the conferencing system including a conference orchestration service (e.g., **611**), a conference state manager (e.g., **612**), a mixer state manager (e.g., **613**), and a set of distributed mixers (e.g., **620**): receiving a request for a new conference via at least one of an application layer interface (e.g., **653**) of the conferencing system and a signaling protocol communication interface (e.g., **651**) of the conference orchestration service (e.g., **611**) (process **S1020**); allocating mixers (e.g., mixers **621a-d**, **622a-d**, **623a-d** of FIG. 6) of the conference, the mixers being mixers of the set of distributed mixers (e.g., **620**) (process **S1020**); and negotiating media across the allocated mixers (process **S1030**). Receiving a request for a new conference includes determining participants of the conference. Allocating mixers of the conference includes generating a mixer topology that specifies an assignment of each determined participant to at least one input channel of at least one mixer of the set of distributed mixers. Negotiating media across the allocated mixers includes routing media of each determined participant to the assigned at least one input channel, and starting the conference. The media is routed according to the generated mixer topology. The mixer state manager (e.g., **613**) generates the topology responsive to an application layer request provided by the conference state manager (e.g., **612**), the conference state manager provides the application layer request responsive to an application layer request

provided by the conference orchestration service (e.g., **611**), the routing is performed by the conference orchestration service in accordance with a signaling protocol, and the conference orchestration service receives the generated mixer topology from the mixer state manager via the conference state manager.

In some implementations, the generated mixer topology is stored by the mixer state manager. In some implementations, the generated mixer topology is stored at the mixer state manager. In some implementations, the generated mixer topology is stored at a storage medium (e.g., **1205** of FIG. 12) of the system **600**.

In some implementations, the system **600** performs the processes **S1010-S1030**. In some implementations, the conference orchestration service **611** (of FIG. 6) performs the process **S1010**. In some implementations, the mixer state manager **613** (of FIG. 6) performs the process **S1020**. In some implementations, the conference orchestration service **611** (of FIG. 6) performs the process **S1030**.

In some implementations, the process **S1010** is similar to the process **S110** of FIG. 2. In some implementations, the process **S1020** is similar to the process **S120** of FIG. 2. In some implementations, the process **S1030** is similar to the process **S130** of FIG. 2.

##### 4.1 Receiving a Request for a New Conference

In some implementations, the process **S1010** functions to control the system **600** to receive a request for a new conference via at least one of an application layer interface (e.g., **653**) of the conferencing system and a signaling protocol communication interface (e.g., **651**) of the conference orchestration service (e.g., **611**). In some implementations, the communication interface **651** of the conference orchestration service **611** receives a request for a new conference from a call router (e.g., the call router **631** of the communication platform **630**). In some implementations, the interface **651** is a SIP interface and the request for a new conference is a SIP request. In some implementations, the application layer interface **653** of the conference state manager **612** receives a request for a new conference via an API request (e.g., of the API **632** of the communication platform **630**). In some implementations, the interface **653** is an HTTP interface. In some implementations, the interface **653** is REST application program interface (API).

In some implementations, the process **S1010** includes determining participants of the conference, as described above for **S110** of FIG. 2. In some implementations, the conference state manager **612** manages conference state of the conference (e.g., the conference state **661**), and the conference state (e.g., **661**) indicates participants of the conference (e.g., as shown in FIG. 7). In some implementations, the conference state (e.g., **661**) is stored by the conference database **614**. In some implementations, the participants of the conference are specified by an API call received by the system **600**. In some implementations, the participants of the conference are specified by an API call received by the application layer interface **653** of the conference state manager **612**. In some implementations, each participant of the conference is identified by an endpoint identifier (e.g., a telephone number). In some implementations, the participants of the conference are specified by at least one conference request (e.g., a SIP request) received by the conference orchestration service **611** via the communication protocol interface **651**.

In some implementations participants include at least one of: a participant transferred from an established communication session (e.g., a communication session of the communication platform **630**) into the conference; a participant

that establishes a communication session (e.g., a communication session of the communication platform **630**) with an endpoint that is mapped to the conference (e.g., a conference of the conference system **600**); and a participant specified by an API request received by the application programming interface (e.g., **653**) of the conferencing system **600**.

In some implementations, determining participants of the conference includes determining participant regions, as described above for **S110** of FIG. 1. In some implementations, the conference orchestration service **611** determines the participant regions of each participant. In some implementations, the conference state manager **612** determines the participant regions of each participant. In some implementations, participant regions are specified by an API call received by the system **600**. In some implementations, participant regions are specified by an API call received by the application layer interface **653** of the conference state manager **612**. In some implementations, the participant regions of the conference are specified by at least one conference request (e.g., a SIP request) received by the conference orchestration service **611** via the communication protocol interface **651**. In some implementations, participant regions of each participant of the conference are identified by respective endpoint identifiers (e.g., a telephone number) of the corresponding participant. In some implementations, participant regions of each participant are determined based on at least one of an area code and a country code of an endpoint (e.g., a telephone number) of the participant. For example, as shown in FIG. 7, participant regions for each of the participants P8, P9 and P11 of the conference 2 (represented by the conference 2 state **712**) are determined to be “California, USA” based on the area code (“415”) of the corresponding telephone numbers. Similarly, as shown in FIG. 7, participant regions for each of the participants P7 and P10 of the conference 2 (represented by the conference 2 state **712**) are determined to be “London, England” based on the country code for England (“44”) and the area code for London (“020”) of the corresponding telephone numbers.

#### 4.1.1 Application Layer Requests

In some implementations, responsive to the request for the new conference, the conference orchestration service **611** provides an application layer request (e.g., an HTTP request) to the conference state manager **612** (process **S1011** of FIG. 10). In some implementations, responsive to the request for the new conference, the application layer interface **652** of the conference orchestration service **611** provides the application layer request to the application layer interface **654** of the conference state manager. In some implementations, the application layer request of the process **S1011** specifies participants of the conference. In some implementations, the application layer request of the process **S1011** specifies participant regions of the participants of the conference.

In some implementations, responsive to the application layer request of the process **S1011**, the conference state manager **612** determines participants of the conference, as described above. In some implementations, responsive to the application layer request of the process **S1011**, the conference state manager **612** determines participant regions of the participants of the conference, as described above.

In some implementations, responsive to the application layer request of the process **S1011**, the conference state manager **612** generates conference state for the conference (e.g., the conference state of FIG. 7). In some implementations, responsive to the application layer request of the process **S1011**, the conference state manager **612** generates conference state for the conference (e.g., the conference

state of FIG. 7) and stores the generated conference state (e.g., as the conference state **661** of the conference database **614**).

In some implementations, the conference state includes the determined participants and the determined participant regions of the participants for the conference.

In some implementations, responsive to the application layer request of the process **S1011**, the conference state manager **612** provides an application layer request (e.g., an HTTP request) to the mixer state manager (process **S1012** of FIG. 10). In some implementations, responsive to the application layer request of the process **S1011**, the application layer interface **655** of the conference state manager **612** provides the application layer request to the application layer interface **656** of the mixer state manager **613**. In some implementations, the application layer request of the process **S1012** specifies participants of the conference. In some implementations, the application layer request of the process **S1012** specifies participant regions of the participants of the conference.

In some implementations, responsive to the application layer request of the process **S1012**, the mixer state manager **613** allocates the mixers of the conference (process **S1020**).

#### 4.2 Allocating Mixers

In some implementations, the process **S1020** functions to control the system **600** to allocate mixers (e.g., the mixers **621a-d**, **622a-d**, and **623a-d**) of the conference (e.g., a conference of the conference states **711**, **712** and **713**), the mixers being mixers of the set of distributed mixers (e.g., **620** of FIG. 6). Allocating mixers includes generating a mixer topology (e.g., a mixer topology of FIGS. 9A-D) that specifies an assignment of each determined participant (e.g., participants P1-P17 of FIGS. 7 and 9A-B) to at least one input channel (e.g., channels 1-6 of FIGS. 8 and 9A-D) of at least one mixer (e.g., the mixers **621a-d**, **622a-d**, and **623a-d**) of the set of distributed mixers (e.g., **620**). In some implementations, the mixer state manager **613** generates the mixer topology (e.g., one of the mixer topologies of FIGS. 9A-D). In some implementations, the mixer state manager **613** stores the mixer topology.

In some implementations the mixer state manager **613** allocates each determined participant to a single mixer. In some implementations, the mixer state manager **613** allocates the determined participants to multiple mixers to provide increased participant capacity for a conference (e.g., as shown in the mixer topology of FIG. 9B). In some implementations, the mixer state manager **613** allocates the determined participants to multiple mixers to provide a subset of the participants with regional mixing within the conference (e.g., as shown in the mixer topology of FIG. 9C). In some implementations, the mixer state manager **613** allocates mixers of the conference by bridging media of the conference between mixers of the set of distributed mixers. In some implementations, the mixer state manager **613** allocates mixers of the conference by bridging media such that a mixer output channel is mixed as an input to a different mixer. In some implementations, the mixer state manager **613** allocates mixers of the conference by allocating mixer output channels of at least two mixers to respective input channels of at least one mixer (e.g., as shown in the mixer topology of FIG. 9D).

In some implementations, responsive to the application layer request of the process **S1012**, the mixer state manager **613** allocates the mixers of the conference (process **S1020**).

In some implementations, the mixer state manager **613** assigns each determined participant to at least one input channel based on a participant region determined for the participant.

In some implementations, the application layer request of the process **S1012** specifies the determined participants. In some implementations, the application layer request of the process **S1012** specifies participant regions of the determined participants. In some implementations, the mixer state manager **613** determines participant regions of the determined participants, as described above.

In some implementations, the mixer state manager **613** assigns each determined participant to at least one input channel of at least one mixer system based on the mixer state **662**. FIG. 8 depicts exemplary mixer state **662**.

In some implementations, the mixer state manager **613** assigns each determined participant to at least one free input channel of at least one mixer system, and the mixer state manager **613** determines whether a mixer input channels is free based on the mixer state **662**. In some implementations, the mixer state manager **613** updates the mixer state **662** after assignment of participants to input channels, to indicate that assigned channels are in use.

As an example, responsive to an application layer request provided by the conference state manager **612** for the conference corresponding to the conference state **711** (of FIG. 7), the mixer state manager **613** assigns participants P1-P6 to previously free channels of mixers **621a**, **621b** and **621c**, and generates the mixer topology **910** of FIGS. 9A and 9B. As shown in FIGS. 9A and 9B, for the conference state **711**, the mixer state manager **613** assigns the participants to channels 2 and 3 of mixer **621a**, channels 2 and 3 of mixer **621b**, and channels 3 and 4 of mixer **621c**. The mixer state manager **613** assigns the output of the mixer **621a** to channel 1 of mixer **621b**, and assigns the output of the mixer **621b** to channel 2 of mixer **621c**. After assignment of the participants P1-P6 to the respective mixer channels, the mixer state **662** indicates the assigned channels as being used, as shown in FIG. 8. More specifically, mixer state **662** indicates channels 2 and 3 of mixer **621a**, channels 1, 2 and 3 of mixer **621b**, channels 2, 3 and 4 of mixer **621c** as being in use.

In some implementations, the mixer state **662** indicates regions of each mixer (e.g., as shown in FIG. 8).

As an example, responsive to an application layer request provided by the conference state manager **612** for the conference corresponding to the conference state **712** (of FIG. 7), the mixer state manager **613** assigns participants P7-P11 to previously free channels of mixers **621d** and **623a**, and generates the mixer topology **920** of FIGS. 9A and 9C. As shown in FIGS. 9A and 9C, for the conference state **712**, the mixer state manager **613** assigns the participants to channels 2, 3 and 4 of mixer **621d**, and channels 3 and 4 of mixer **623a**. The mixer state manager **613** assigns the output of the mixer **621d** to channel 2 of mixer **623a**. After assignment of the participants P7-P11 to the respective mixer channels, the mixer state **662** indicates the assigned channels as being used, as shown in FIG. 8. More specifically, mixer state **662** indicates channels 2, 3 and 4 of mixer **621d**, and channels 2, 3 and 4 of mixer **623a** as being in use. For the for the conference state **712**, the mixer state manager **613** assigns the participants P8, P9 and P11 (which have “California, USA” as a participant region, e.g., as indicated by the “415” telephone number area code) to the mixer **621d**, which is a mixer of region “California, USA” (as indicated by the mixer state **662**), and the mixer state manager **613** assigns the participants P7 and P10 (which have “London, England” as a participant region, e.g., as

indicated by the “44” country code and “020” telephone number area code) to the mixer **623a**, which is a mixer of region “London, England” (as indicated by the mixer state **662**).

As an example, responsive to an application layer request provided by the conference state manager **612** for the conference corresponding to the conference state **713** (of FIG. 7), the mixer state manager **613** assigns participants P12-P17 to previously free channels of mixers **621a**, **621b** and **622d**, and generates the mixer topology **930** of FIGS. 9A and 9D. As shown in FIGS. 9A and 9D, for the conference state **713**, the mixer state manager **613** assigns the participants to channels 5 and 6 of mixer **621a**, channels 5 and 6 of mixer **621b**, and channels 3 and 4 of mixer **622d**. The mixer state manager **613** assigns the output of the mixer **621a** to channel 1 of mixer **622d**, and assigns the output of the mixer **621b** to channel 2 of mixer **622d**. After assignment of the participants P12-P17 to the respective mixer channels, the mixer state **662** indicates the assigned channels as being used, as shown in FIG. 8.

In some implementations, the mixer state manager **613** allocates mixers as described above for **S120** of FIG. 2. In some implementations, the mixer state manager **613** allocates mixers based on at least one of communication quality, packet loss, latency, packet dial delay (PDD), monetary cost to the platform provider, monetary price charged to account holder, media quality, mixer capacity, regional associations of participants and mixers, participant priority, and the like.

In some implementations, the mixer state manager **613** stores the generated mixer topology.

In some implementations, the mixer state manager **613** provides the generated mixer topology (e.g., one of the topologies **910**, **920**, and **930** of FIG. 9A) to the conference state manager **612** (process **S1021**). In some implementations, the mixer state manager **613** provides the generated mixer topology to the conference state manager **612** via at least one of an application layer response and an application layer request. In some implementations, mixer state manager **613** uses the application layer interface **656** to provide the generated mixer topology to the application layer interface **655** of the conference state manager **612**.

In some implementations, responsive to the mixer topology provided by the mixer state manager **613**, the conference state manager **612** provides the mixer topology to the conference orchestration service manager **611** (process **S1022**). In some implementations, the conference state manager **612** provides the mixer topology to the conference orchestration service manager **611** via at least one of an application layer response and an application layer request. In some implementations, the conference state manager **612** provides the mixer topology to the conference orchestration service manager **611** uses the application layer interface **654** to provide the mixer topology to the application layer interface **652** of the conference orchestration service **611**. In some implementations, the conference orchestration service **611** stores the topology (e.g., as one of the mixer topologies **663**).

In some implementations, responsive to the mixer topology (e.g., received provided at the process **S1022**), the conference orchestration service **611** negotiates media across the allocated mixers (process **S1030**).

#### 4.2.1 Bridging Mixers

In some implementations, the mixer bridging of two mixers is performed by the mixer state manager **613**. In some implementations, the bridging of two mixers is performed by the mixer state manager **613** during generation of the mixer topology (e.g., **910**, **920**, **930**), and the mixer state



manager **613** bridges two mixers by instructing a main mixer (e.g., a mixer whose output is provided to an input of a child mixer) to dial in to a child mixer.

In some implementations, the mixer state manager **613** instructs the main mixer to dial in to the child mixer by providing an application layer request (e.g., an HTTP REST call) to the main mixer, the application layer request specifying the mixer identifier of the child mixer and the channel identifier of the channel to receive the output of the main mixer. In some implementations, responsive to the application layer request received by the main mixer, the main mixer dials into the child mixer and bridges the output of the main mixer to the input channel identified by the channel identifier by: providing the child mixer with a SIP INVITE message that specifies the main mixer in a SIP "From" header, specifies a mixer identifier of the child mixer as a parameter to the SIP INVITE message, and specifies the channel identifier of the channel in a custom SIP header (e.g., a SIP X-Header).

In some implementations, the mixer state manager **613** instructs the main mixer to dial in to the child mixer by providing an communication protocol interface request (e.g., a request provided by the communication protocol interface **657**) (e.g., a SIP message) to the main mixer, the communication protocol interface request (e.g., SIP message) specifying the mixer identifier of the child mixer and the channel identifier of the channel to receive the output of the main mixer. In some implementations, responsive to the communication protocol interface request (e.g., SIP message) received by the main mixer, the main mixer dials into the child mixer and bridges the output of the main mixer to the input channel identified by the channel identifier by: providing the child mixer with a SIP INVITE message that specifies the main mixer in a SIP "From" header, specifies a mixer identifier of the child mixer as a parameter to the SIP INVITE message, and specifies the channel identifier of the channel in a custom SIP header (e.g., a SIP X-Header).

In some implementations, the bridging of two mixers, as described above, is performed by the conference orchestration service **611**.

#### 4.3 Negotiating Media

In some implementations, the process **S1030** functions to control the system **600** to negotiate media across the allocated mixers (e.g., the mixer systems allocated at the process **S1020**). In some implementations, negotiating media across the allocated mixers includes routing media of each determined participant to the respective assigned mixer input channel. In some implementations, negotiating media across the allocated mixers includes starting the conference. In some implementations, the routing is performed by the conference orchestration service **611** in accordance with a signaling protocol.

In some implementations, the conference orchestration service **611** negotiates the media across the allocated mixers by routing media of each conference participant (e.g., participant media received from the call router **631** via the communication protocol interface **651**) to a respective mixer input channel. In some implementations, the conference orchestration service **611** determines a mixer input channel for a conference participant based on the mixer topology generated by the mixer state manager **613** for the conference (e.g., a mixer topology of the topologies **663**). In some implementations, the conference orchestration service **611** uses the communication protocol interface **651** to receive participant media from the communication platform **630** (e.g., from the call router **631**). In some implementations, participant media is media of a communication session of

the communication platform **630**. In some implementations, the conference orchestration service **611** uses the communication protocol interface **651** to provide media of each participant of the conference to a respective mixer channel. In some implementations, the communication protocol interface **651** is a SIP interface, the conference orchestration service **611** uses the communication protocol interface **651** to receive participant media, and the conference orchestration service **611** uses the communication protocol interface **651** to provide media of each participant of the conference to a respective mixer channel.

In some implementations, negotiating the media across the allocated mixers includes the conference orchestration service **611** using the communication protocol interface **651** to perform signaling handshaking between media resources of the conference (e.g., participant media resources of the conference) and mixers allocated to the conference (as indicated by the mixer topology of the conference). In some implementations, the signaling handshaking is performed in accordance with SIP. In some implementations, the conference orchestration service **611** establishes the mixer topology by sending each mixer of the topology a SIP INVITE message that specifies at least a corresponding mixer identifier and a channel identifier assigned to the corresponding participant as indicated by the mixer topology (e.g., a topology of the mixer topologies **663**). In some implementations, the conference orchestration service **611** establishes the mixer topology by sending each mixer of the topology a SIP INVITE message that specifies at least a corresponding conference participant, mixer identifier and a channel identifier assigned to the corresponding participant as indicated by the mixer topology (e.g., a topology of the mixer topologies **663**).

In some implementations, the conference orchestration service **611** establishes the mixer topology by: determining conference participants (as described above); for each participant, determining the assigned mixer and channel as indicated by the mixer topology (e.g., one of the topologies **663**) for the conference; for each participant, providing a SIP INVITE message to the assigned mixer. In some implementations, the SIP INVITE message specifies the conference participant in a SIP "From" header, specifies a mixer identifier of the mixer (as identified by the mixer topology) as a parameter to the SIP INVITE request, and specifies a channel identifier of the channel (as identified by the mixer topology) in a custom SIP header (e.g., a SIP X-Header).

As an example, for the conference 1 of the mixer topology **910** of FIGS. 9A and 9B, the conference orchestration service **611** routes media of participant P1 (received at interface **651**, e.g., a SIP interface) to the channel 2 of the mixer **621a** (e.g., by using SIP), routes media of participant P2 (received at interface **651**) to the channel 3 of the mixer **621a** (e.g., by using SIP), routes media of participant P3 (received at interface **651**) to the channel 2 of the mixer **621b** (e.g., by using SIP), routes media of participant P4 (received at interface **651**) to the channel 3 of the mixer **621b** (e.g., by using SIP), routes media of participant P5 (received at interface **651**) to the channel 3 of the mixer **621c** (e.g., by using SIP), and routes media of participant P6 (received at interface **651**) to the channel 4 of the mixer **621c** (e.g., by using SIP). The output of the mixer **621a** is bridged to the channel 1 of the mixer **621b**, the output of the mixer **621b** is bridged to the channel 2 of the mixer **621c**, and the bridging of the mixer outputs is performed as described above. The output of the mixer **621c** is the output of the mixer topology **910**, and therefore the output of the mixer **621c** is provided by the mixer **621c** to the conference

orchestration service **611** (e.g., via SIP), and the conference orchestration service **611** provides the output of the mixer **621c** to each conference participant via respective communication sessions (e.g., SIP communication sessions) (e.g., communication sessions of the call router **631**).

## 5. METHOD OF FIG. 11

The method **1100** of FIG. **11** is performed at a conferencing system (e.g., **600** of FIG. **6**) constructed to operate scalable conferencing services, the conferencing system including a conference orchestration service (e.g., **611**), a conference state manager (e.g., **612**), a mixer state manager (e.g., **613**), and a set of distributed mixers (e.g., **620**), and the method is performed responsive to a request for a new conference that is received via at least one of an application layer interface (e.g., **653**) of the conferencing system and a signaling protocol communication interface (e.g., **651**) of the conference orchestration service (e.g., **611**). The method **1100** includes: determining participants of the conference and participant regions for each determined participant (process **S1100**); generating a mixer topology (e.g., a mixer topology of FIGS. **9A-D**) by using the mixer state manager (e.g., **613**), the mixer topology specifying an assignment of each determined participant to at least one input channel of a plurality of mixers of the set of distributed mixers (e.g., **620**), the mixer state manager generating the mixer topology based on the determined participant regions and at least one regional association of a mixer of the set of distributed mixers (process **S1120**); and routing media of each determined participant to the assigned at least one input channel according to the generated mixer topology by using the conference orchestration service (e.g., **611**) (process **S1130**). The mixer state manager (e.g., **613**) generates the topology responsive to an application layer request provided by the conference state manager (e.g., **612**), the conference state manager provides the application layer request responsive to an application layer request provided by the conference orchestration service (e.g., **611**), the routing is performed by the conference orchestration service in accordance with a signaling protocol, and the conference orchestration service receives the generated mixer topology from the mixer state manager via the conference state manager.

In some implementations, the generated mixer topology is stored by the mixer state manager. In some implementations, the generated mixer topology is stored at the mixer state manager. In some implementations, the generated mixer topology is stored at a storage medium (e.g., **1205** of FIG. **12**) of the system **600**.

In some implementations, the system **600** performs the processes **S1110-S1130**. In some implementations, the conference orchestration service **611** (of FIG. **6**) performs the process **S1110**. In some implementations, the mixer state manager **613** (of FIG. **6**) performs the process **S1120**. In some implementations, the conference orchestration service **611** (of FIG. **6**) performs the process **S1130**.

In some implementations, the process **S1110** is similar to the process **S1010** of FIG. **10**. In some implementations, the process **S1120** is similar to the process **S1020** of FIG. **10**. In some implementations, the process **S1130** is similar to the process **S1030** of FIG. **10**.

In some implementations, the mixer state manager manages mixer state information for each mixer of the set of distributed mixers, and the mixer state information specifies a regional association of at least one mixer of the set of distributed mixers.

In some implementations, for each mixer managed by the mixer state manager, the mixer state information indicates a state for each input channel of the mixer. The mixer state manager assigns each determined participant to at least one free input channel of a plurality of mixers of the set of distributed mixers, and each free input channel is identified by the mixer state information.

In some implementations, the conference state is managed by the conference state manager, the conference state manager provides the conference state to the mixer state manager via the application layer request provided by the conference state manager, and the mixer state manager generates the mixer topology by using the conference state.

In some implementations, the mixer state manager determines the participant regions for each determined participant by using the conference state provided by the conference state manager. The mixer state manager determines regions for each mixer by using the mixer state managed by the mixer state manager. For at least one determined participant, the mixer state manager determines a mixer located in a region that matches the participant region of the determined participant, and the mixer state manager assigns the determined participant to an input channel of the mixer located in the matching region.

In some implementations, the mixer state manager assigns each determined participant to at least one input channel based on respective participant priority values.

## 6. SYSTEM ARCHITECTURE: CONFERENCE SYSTEM

FIG. **12** is an architecture diagram of a system (e.g., the conference system **600** of FIG. **6**) according to an implementation in which the system is implemented by a server device. In some implementations, the system is implemented by a plurality of devices. In some implementations, the system **600** is similar to the system **100** of FIG. **1**.

The bus **1201** interfaces with the processors **1201A-1201N**, the main memory (e.g., a random access memory (RAM)) **1222**, a read only memory (ROM) **1204**, a processor-readable storage medium **1205**, a display device **1207**, a user input device **1208**, and a network device **1211**.

The processors **1201A-1201N** may take many forms, such as ARM processors, X86 processors, and the like.

In some implementations, the system (e.g., **600**) includes at least one of a central processing unit (processor) and a multi-processor unit (MPU).

The processors **1201A-1201N** and the main memory **1222** form a processing unit **1299**. In some embodiments, the processing unit includes one or more processors communicatively coupled to one or more of a RAM, ROM, and machine-readable storage medium; the one or more processors of the processing unit receive instructions stored by the one or more of a RAM, ROM, and machine-readable storage medium via a bus; and the one or more processors execute the received instructions. In some embodiments, the processing unit is an ASIC (Application-Specific Integrated Circuit). In some embodiments, the processing unit is a SoC (System-on-Chip). In some embodiments, the processing unit includes one or more of a conference management system, a conference orchestration service, a conference state manager, a mixer state manager, and a conference database, and mixing resources.

The network adapter device **1211** provides one or more wired or wireless interfaces for exchanging data and commands between the system (e.g., **600**) and other devices, such as a mixer, and a communication platform (e.g., **630**).

Such wired and wireless interfaces include, for example, a universal serial bus (USB) interface, Bluetooth interface, Wi-Fi interface, Ethernet interface, near field communication (NFC) interface, and the like.

Machine-executable instructions in software programs (such as an operating system, application programs, and device drivers) are loaded into the memory **1222** (of the processing unit **1299**) from the processor-readable storage medium **1205**, the ROM **1204** or any other storage location. During execution of these software programs, the respective machine-executable instructions are accessed by at least one of processors **1201A-1201N** (of the processing unit **1299**) via the bus **1201**, and then executed by at least one of processors **1201A-1201N**. Data used by the software programs are also stored in the memory **1222**, and such data is accessed by at least one of processors **1201A-1201N** during execution of the machine-executable instructions of the software programs. The processor-readable storage medium **1205** is one of (or a combination of two or more of) a hard drive, a flash drive, a DVD, a CD, an optical disk, a floppy disk, a flash storage, a solid state drive, a ROM, an EEPROM, an electronic circuit, a semiconductor memory device, and the like. The processor-readable storage medium **1205** includes machine-executable instructions (and related data) for an operating system **1212**, software programs **1213**, device drivers **1214**, mixing resources **1215**, and the conference management system **610**. The machine-executable instructions (and related data) for the mixing resources **1215** include machine-executable instructions (and related data) for one or more mixers (e.g., a mixer of the distributed mixing resources **620** of FIG. **6**). The machine-executable instructions (and related data) for the conference management system **610** include machine-executable instructions (and related data) for the conference orchestration service **611**, the conference state manager **612**, the mixer state manager **613**, and the conference database **614**.

In some implementations, the conference management system **610** is implemented as a server device that is separate from server devices of the mixing resources.

## 7. SYSTEM ARCHITECTURE: MIXER DEVICE

FIG. **13** is an architecture diagram of a mixer region (e.g., the mixer region **621** of FIG. **6**) according to an implementation in which the mixer region is implemented by a server device. In some implementations, the mixer region is implemented by a plurality of devices. In some implementations, the mixer region is similar to the mixer regions of **120** of FIG. **1**.

The bus **1301** interfaces with the processors **1301A-1301N**, the main memory (e.g., a random access memory (RAM)) **1322**, a read only memory (ROM) **1304**, a processor-readable storage medium **1305**, a display device **1307**, a user input device **1308**, and a network device **1311**.

The processors **1301A-1301N** may take many forms, such as ARM processors, X86 processors, and the like.

In some implementations, the server device includes at least one of a central processing unit (processor) and a multi-processor unit (MPU).

The processors **1301A-1301N** and the main memory **1322** form a processing unit **1399**. In some embodiments, the processing unit includes one or more processors communicatively coupled to one or more of a RAM, ROM, and machine-readable storage medium; the one or more processors of the processing unit receive instructions stored by the one or more of a RAM, ROM, and machine-readable storage medium via a bus; and the one or more processors execute

the received instructions. In some embodiments, the processing unit is an ASIC (Application-Specific Integrated Circuit). In some embodiments, the processing unit is a SoC (System-on-Chip). In some embodiments, the processing unit includes one or more mixers.

The network adapter device **1311** provides one or more wired or wireless interfaces for exchanging data and commands between the server device and other devices, such as a server device of a conference management system (e.g., **610**). Such wired and wireless interfaces include, for example, a universal serial bus (USB) interface, Bluetooth interface, Wi-Fi interface, Ethernet interface, near field communication (NFC) interface, and the like.

Machine-executable instructions in software programs (such as an operating system, application programs, and device drivers) are loaded into the memory **1322** (of the processing unit **1399**) from the processor-readable storage medium **1305**, the ROM **1304** or any other storage location. During execution of these software programs, the respective machine-executable instructions are accessed by at least one of processors **1301A-1301N** (of the processing unit **1399**) via the bus **1301**, and then executed by at least one of processors **1301A-1301N**. Data used by the software programs are also stored in the memory **1322**, and such data is accessed by at least one of processors **1301A-1301N** during execution of the machine-executable instructions of the software programs. The processor-readable storage medium **1305** is one of (or a combination of two or more of) a hard drive, a flash drive, a DVD, a CD, an optical disk, a floppy disk, a flash storage, a solid state drive, a ROM, an EEPROM, an electronic circuit, a semiconductor memory device, and the like. The processor-readable storage medium **1305** includes machine-executable instructions (and related data) for an operating system **1312**, software programs **1313**, device drivers **1314**, and the mixers **621a-d**.

## 8. MACHINES

The system and methods of the preferred embodiments and variations thereof can be embodied and/or implemented at least in part as a machine configured to receive a computer-readable medium storing computer-readable instructions. The instructions are preferably executed by computer-executable components preferably integrated with the media and signaling components of a conferencing system. The computer-readable medium can be stored on any suitable computer-readable media such as RAMs, ROMs, flash memory, EEPROMs, optical devices (CD or DVD), hard drives, floppy drives, or any suitable device. The computer-executable component is preferably a general or application specific processor, but any suitable dedicated hardware or hardware/firmware combination device can alternatively or additionally execute the instructions.

## 9. CONCLUSION

As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims.

What is claimed is:

1. A method comprising:

receiving, by a conferencing system, a request to initiate a first conference including at least a first participant and a second participant, wherein the conferencing

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system manages mixer state information that specifies, for each respective mixer of a plurality of mixers, a geographic region serviced by the respective mixer and a set of available mixer input channels of the respective mixer, each respective mixer of the plurality of mixers bridging media to endpoints located within the geographic region serviced by the respective mixer;

determining a first area code of a phone number assigned to a first endpoint of the first participant of the first conference, the first area code corresponding to a first geographic region in which endpoints are assigned the first area code;

determining whether the plurality of mixers includes at least one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel;

responsive to a determination that the plurality of mixers does not include at least a one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel:

allocating a new mixer in the first geographic region corresponding to the first area code, and

assigning the first endpoint to a first available mixer input channel of the new mixer;

providing a first invite message to the new mixer, wherein the first invite message specifies the first endpoint, a mixer identifier of the new mixer, and a channel identifier of the first available mixer input channel of the new mixer;

establishing the first conference including at least the first participant and the second participant, the first conference utilizing the new mixer allocated in the first geographic region to receive media from the first endpoint via the first available mixer input channel and transmit the media received from the first endpoint to at least a second endpoint of the second participant of the first conference, and receive media from at least the second endpoint and transmit the media received from at least the second endpoint to the first endpoint via the first available mixer input channel.

2. The method of claim 1, wherein the first invite message is a SIP INVITE message.

3. The method of claim 1, further comprising:

determining the first area code of the phone number assigned to the first endpoint of the first participant of the first conference.

4. The method of claim 1, further comprising:

determining a second area code of a phone number assigned to a second endpoint of a second participant of the first conference, the second area code corresponding to a second geographic region;

determining that a second mixer of the plurality of mixers is located in the second geographic region;

assigning the second participant to an available mixer input channel of the second mixer; and

providing a second invite message to the second mixer, wherein the second invite message specifies the second participant, a mixer identifier of the second mixer, and a channel identifier of the available mixer input channel of the second mixer.

5. The method of claim 4, wherein the first geographic region is different from the second geographic region, and the first area code is different from the second area code.

6. The method of claim 4, wherein the second geographic region matches the first geographic region, and the first area code matches the second area code.

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7. The method of claim 1, further comprising:

responsive to determining that a first mixer in the first geographic region is not assigned to any participant, removing the first mixer from the first geographic region.

8. A conferencing system comprising:

one or more computer processors; and

one or more computer-readable mediums storing instructions that, when executed by the one or more computer processors, cause the conferencing system to perform operations comprising:

receiving a request to initiate a first conference including at least a first participant and a second participant, wherein the conferencing system manages mixer state information that specifies, for each respective mixer of a plurality of mixers, a geographic region serviced by the respective mixer and a set of available mixer input channels of the respective mixer, each respective mixer of the plurality of mixers bridging media to endpoints located within the geographic region serviced by the respective mixer;

determining a first area code of a phone number assigned to a first endpoint of the first participant of the first conference, the first area code corresponding to a first geographic region in which endpoints are assigned the first area code;

determining whether the plurality of mixers includes at least one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel;

responsive to a determination that the plurality of mixers does not include at least a one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel:

allocating a new mixer in the first geographic region corresponding to the first area code, and

assigning the first endpoint to a first available mixer input channel of the new mixer;

providing a first invite message to the new mixer, wherein the first invite message specifies the first endpoint, a mixer identifier of the new mixer, and a channel identifier of the first available mixer input channel of the new mixer;

establishing the first conference including at least the first participant and the second participant, the first conference utilizing the new mixer allocated in the first geographic region to receive media from the first endpoint via the first available mixer input channel and transmit the media received from the first endpoint to at least a second endpoint of the second participant of the first conference, and receive media from at least the second endpoint and transmit the media received from at least the second endpoint to the first endpoint via the first available mixer input channel.

9. The conferencing system of claim 8, wherein the first invite message is a SIP INVITE message.

10. The conferencing system of claim 8, the operations further comprising:

determining the first area code of the phone number assigned to the first endpoint of the first participant of the first conference.

11. The conferencing system of claim 8, the operations further comprising:

determining a second area code of a phone number assigned to a second endpoint of a second participant of

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the first conference, the second area code corresponding to a second geographic region;  
 determining that a second mixer of the plurality of mixers is located in the second geographic region;  
 assigning the second participant to an available mixer input channel of the second mixer; and  
 providing a second invite message to the second mixer, wherein the second invite message specifies the second participant, a mixer identifier of the second mixer, and a channel identifier of the available mixer input channel of the second mixer.

12. The conferencing system of claim 11, wherein the first geographic region is different from the second geographic region, and the first area code is different from the second area code.

13. The conferencing system of claim 11, wherein the second geographic region matches the first geographic region, and the first area code matches the second area code.

14. The conferencing system of claim 8, the operations further comprising:

responsive to determining that a first mixer in the first region is not assigned to any participant, removing the first mixer from the first geographic region.

15. A non-transitory computer-readable medium storing instructions that, when executed by the one or more computer processors of a conferencing system, cause the conferencing system to perform operations comprising:

receiving a request to initiate a first conference including at least a first participant and a second participant, wherein the conferencing system manages mixer state information that specifies, for each respective mixer of a plurality of mixers, a geographic region serviced by the respective mixer and a set of available mixer input channels of the respective mixer, each respective mixer of the plurality of mixers bridging media to endpoints located within the geographic region serviced by the respective mixer;

determining a first area code of a phone number assigned to a first endpoint of the first participant of the first conference, the first area code corresponding to a first geographic region in which endpoints are assigned the first area code;

determining whether the plurality of mixers includes at least one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel;

responsive to a determination that the plurality of mixers does not include at least one mixer that is located within the first geographic region corresponding to the first area code and that has at least one free input channel:

allocating a new mixer in the first geographic region corresponding to the first area code, and

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assigning the first endpoint to a first available mixer input channel of the new mixer;

providing a first invite message to the new mixer, wherein the first invite message specifies the first endpoint, a mixer identifier of the new mixer, and a channel identifier of the first available mixer input channel of the new mixer;

establishing the first conference including at least the first participant and the second participant, the first conference utilizing the new mixer allocated in the first geographic region to receive media from the first endpoint via the first available mixer input channel and transmit the media received from the first endpoint to at least a second endpoint of the second participant of the first conference, and receive media from at least the second endpoint and transmit the media received from at least the second endpoint to the first endpoint via the first available mixer input channel.

16. The non-transitory computer-readable medium of claim 15, wherein the first invite message is a SIP INVITE message.

17. The non-transitory computer-readable medium of claim 15, the operations further comprising:

determining the first area code of the phone number assigned to the first endpoint of the first participant of the first conference.

18. The non-transitory computer-readable medium of claim 15, the operations further comprising:

determining a second area code of a phone number assigned to a second endpoint of a second participant of the first conference, the second area code corresponding to a second geographic region;

determining that a second mixer of the plurality of mixers is located in the second geographic region;

assigning the second participant to an available mixer input channel of the second mixer; and

providing a second invite message to the second mixer, wherein the second invite message specifies the second participant, a mixer identifier of the second mixer, and a channel identifier of the available mixer input channel of the second mixer.

19. The non-transitory computer-readable medium of claim 18, wherein the first geographic region is different from the second geographic region, and the first area code is different from the second area code.

20. The non-transitory computer-readable medium of claim 15, the operations further comprising:

responsive to determining that a first mixer in the first region is not assigned to any participant, removing the first mixer from the first geographic region.

\* \* \* \* \*